SkyTel *
Skybridge Spectrum Foundation |
Telesaurus Holdings GB LLC | V2G LLC |
Environmentel LLC | Verde Systems LLC |
Intelligent Transportation & Monitoring Wireless LLC

Warren Havens, President

June 19, 2014

Ex parte meeting report, WT Docket 12-229

On Tuesday June 17, 2012, the undersigned, Warren Havens, met with FCC staff at FCC offices: Richard Arsenault, Jon Osler, Heather Moelter, Thomas Derenge, Roger Noel (ph), Scot Stone, Kathy Harris (ph), and Becky Schwartz (ph).1

Mr. Havens presented matters reflected in three documents he emailed to the FCC staff prior to the meeting: the email string and these attachments are included as attachments to this report.2.

The matters presented involve the M-LMS licenses in this docket 12-229, and also touched upon other licenses of the nonprofit and for-profit companies Mr. Havens manages (sometimes called the "SkyTel" companies), listed above, in accord with their joint plans for nationwide wireless in support of Intelligent Transportation Systems ("ITS") and other critical systems that involve all of their licenses (M-LMS and other licenses). 3

Mr. Havens noted that it has been approximately 11 years since the FCC commenced rule-change proceedings regarding all M-LMS licenses and spectrum. This was began in 2003 with RM-10403 (initiated by a "Progeny" entity), which was carried forward from 2006 by the NPRM proceeding 06-49 until the Commission decision of last week in FCC 14-79 (see footnote 2 below) to terminate the NPRM with no rule changes. Mr. Havens noted that until this decision,

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* "SkyTel" means the LLCs and Foundation listed above.

1 "(ph)" means that the person attended the meeting by telephone.

2 Mr. Havens referred to FCC 14-79, the M-LMS Order terminating NPRM ("... terminate the above-captioned Multilateration Location and Monitoring Service (M-LMS) rulemaking proceeding, and conclude that the various proposals for broad revisions of the applicable rules do not merit further consideration at this time."). This is also referenced in the meeting-setup email attached hereto as Attachment 1 of 4.

3 In this regard, Mr. Havens explained the value of using the three spectrum ranges involved-- 900 MHz LMS, 200 MHz AMTS, and low-band VHF in 35 and 43 MHz-- for his companies' plans noted at the meeting and in this report. In sum, they are needed in combination for ubiquitous robust coverage, and sufficient capacity in both the urban areas (the 900 MHz will provide the majority of the capacity) and all other areas (in which the lower spectrum will provide the, or the fundamental, capacity).

his M-LMS licensee companies could not substantially progress their implementation plans, since the rules were "up in the air."

He noted that FCC 14-79 decided *in accord with* these SkyTel companies' positions in these rule-change proceedings, and thus these companies can now proceed with their implementation plans *if the M-LMS licenses are renewed and the construction-deadline extension requests granted,* and the private-commons applications are accepted (see below).

Mr. Havens explained his SkyTel companies' planned delivery of N-RTK GPS corrections nationwide for precision PNT (Position, Navigation and Timing) with ubiquitous coverage, at no cost to the public (and government operations) using open signals like GPS. This will be to any mobile and fixed radio receive device, in large part by using DMR+ tech and systems (a new type of digital OFDM radio broadcast that is highly cost- and spectrum- efficient) in the 35 and 43 MHz and lower-200 MHz AMTS spectrum licenses of these SkyTel companies, in support of wide-area ITS radio services using the M-LMS licenses, drawing on the last two attachments hereto.[4] As the SkyTel companies explained in past filings including in docket 06-49, the M-LMS licenses will also be used to deliver N-RTK corrections (in addition to multilateration), but the upper limit of DMR+ is in lower 200 MHz, and in addition, these lower-frequency licenses have major advantages regarding long-range robust coverage nationwide needed for ITS.

Mr. Havens noted that the actual and viable market for these critical transport and other systems, including their wireless components, is not based on EAs (used in M-LMS licensing) but is nationwide, built on multi-city transport regions, and thus, viable license construction and operation deployment must follow this market reality. Thus, he explained, consolidation of licenses of some kind may be sought.

Also presented by Mr. Havens was the use of TD-LTE with intrinsic multilateration and tightly coupled communications (vehicle to infrastructure, or V2I, and vehicle to vehicle, or V2V) for these M-LMS licenses.

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4 Mr. Havens also explained how the 35 and 43 MHz licenses can be used, and under his companies' plans will be used in part, for meteor-burst communications, multi-static radar, and high-accuracy timing, and together, for meteor burst PNT that will be highly valuable as an independent PNT system to GPS for the nation. He explained the current US DOA use of meteor burst communications for remote environmental monitoring station telemetry over most of the nation (hundreds of stations in the DOA SNOTEL and SCAN systems) and that it is a robust successful "traditional" intermittent-telemetry meteor burst communication system using only a few channels and master base stations. He noted that his companies plan a "next-generation" MBC system covering the nation and beyond, and how it can be implemented with, as compared to the DOA system, far wider and more channels, advanced over-the-air and antenna technologies, more master stations with redundant coverage, synchronized remote antennas in proximity for gain, etc. Some of the pages in attachments hereto, presented at the meeting, depict and describe this meteor-burst wireless topic.

He further explained the need for multiple location (more broadly, PNT) methods and implementations for critical transportation and other systems: thus the need for N-RTK, terrestrial and MBC (meteor burst communications) multilateration, INS (inertial navigation systems), on-board radar and lidar, etc. For example, he explained that GPS signals are substantially blocked and subject to radio multipath in urban areas, and this causes inaccurate location determinations, and this cannot be cured by N-RTK. He also explained that it is easy to jam and spoof GPS. For these and other reasons, the noted multiple methods and implementations are essential for critical PNT and these must be, like GPS nationwide, ubiquitous and available to all at no cost: that is and has been for years the core plan of the SkyTel companies Mr. Havens spoke for at the meeting and that submit this report.

Mr. Havens asked when FCC staff would decide upon the pending construction-deadline extension requests and the related license renewal requests of the M-LMS licenses of Skybridge Spectrum Foundation and Telesaurus Holdings GB LLC. As reflected in the email attached hereto, FCC staff indicated that they expect decisions to be released this summer and had no current questions.

Mr. Havens noted that these M-LMS licensees plan to submit additional FCC filings, in the near future, with supplementary information in support of these pending renewal and extension requests submitted several years ago. Also for this purpose, this report may be filed on the lead call signs of these licenses.

In addition, FCC staff indicated that the FCC would act on and give notice of the action on the private-commons filings by the M-LMS licenses listed above. Private commons involves advanced peer-to-peer wireless with coordination of the authorized users and use by the licensee for spectrum efficiencies and other benefits (unlike public commons wireless in which use is not coordinated and causes interference and spectrum-use inefficiencies). These private-commons applications are for purposes that include ITS V2V (see above), a core ITS function that cannot be provided by DSRC alone (see below). It was also noted that these are the first applications seeking private-commons regulatory status that the FCC has received. Prior communications on this topic between Mr. Havens and FCC staff were also noted.

In this regard, Mr. Havens noted that DSRC at 5.9 GHz (the "sister" ITS radio service of LMS) provides only short-range communications (as implied by its name, "Dedicated Short Range Communications") but that ITS needs, at its core, very wide-area wireless on lower spectrum, as noted above, and for which the FCC allocated the LMS spectrum in the mid-1990's. Mr. Havens noted that M-LMS (and all of LMS, including N-LMS also) and DRSC are complementary, and to illustrate this, he noted that Japan studied ITS wireless and decided to allocate spectrum in the upper 700 MHz range, to use with its version of DRSC, for similar wide-area ITS wireless that can be provided by M-LMS in the United States.

Matters indicated in the email string attached hereto that are not described in this report were not discussed in the meeting.

Mr. Havens thanked the FCC staff for their consideration of his presentation and inquires for the SkyTel companies and their availability on short notice.

A copy of this report, after its filing in docket 12-229 on ECFS, will be emailed to each of the FCC staff persons listed above who attended the meeting.

Respectfully submitted,

Warren Havens
President of each
"SkyTel" companies (see p. 1)
2509 Stuart Street
Berkeley CA 94705
warren.havens@sbcglobal.net
jstobaugh@telesaurus.com
Phone 510 841 2220

Attachments, referenced above, follow

(There are 53 pages total in this report.)

Subject:	Re: Tues 11 am meeting / Re: Request for meeting Jn 16, 17, or 18 / Re: Questions re: 1) M-LMS order of this week. 2) dedicated AMTS for US passenger rail
From:	eitt líf koma nú griðastaðir (warren.havens@sbcglobal.net)
To:	Richard.Arsenault@fcc.gov; Scot.Stone@fcc.gov; Roger.Noel@fcc.gov; kathy.harris@fcc.gov; Becky.Schwartz@fcc.gov;
Cc:	jstobaugh@telesaurus.com;
Date:	Tuesday, June 17, 2014 9:35 AM

Attached are three items: I will refer to some pages and items in these today.

After a brief presentation, for the most part, I have questions of the FCC on
- FCC standards and preferences (what actually counts?) re our pending and contemplated applications and requests regarding:
    - Private Commons (our existing application, and other)
    - M-LMS topics
    - AMTS topics
    - VHF low band ("Paging" - Part 22) topics
- "Moving" spectrum from FCC to NTIA (cancelation at FCC, contracts with federal agencies)
- Any other means by which we may pursue our plans. This takes agency knowledge and interest we do not find at the FCC: we are not traditional commercial wireless, not public safety, etc. but pursue major federal agency goals in realistic technical and market time frames.

Thank you,
W. Havens

From: eitt líf koma nú griðastaðir <warren.havens@sbcglobal.net>
To: Richard Arsenault <Richard.Arsenault@fcc.gov>
Cc: Jimmy Stobaugh <jstobaugh@telesaurus.com>
Sent: Monday, June 16, 2014 12:08 PM
Subject: Tues 11 am meeting / Re: Request for meeting Jn 16, 17, or 18 / Re: Questions re: 1) M-LMS order of this week. 2) dedicated AMTS for US passenger rail

Thanks, see you then.

From: Richard Arsenault <Richard.Arsenault@fcc.gov>
To: 'eitt líf koma nú griðastaðir' <warren.havens@sbcglobal.net>

Cc: Jimmy Stobaugh <jstobaugh@telesaurus.com>; Richard Arsenault <Richard.Arsenault@fcc.gov>
Sent: Monday, June 16, 2014 12:02 PM
Subject: RE: Request for meeting Jn 16, 17, or 18 / Re: Questions re: 1) M-LMS order of this week. 2) dedicated AMTS for US passenger rail

1 hour sir.

Myself, Scot Stone, Becky Schwartz (ph), Roger Noel (ph), and Kathy Harris (ph).

Let's start with private commons--Kathy.

We are in Portals "1"; not the main FCC HQ building (Portals 2). The entrance is to the left of the Mandarin Oriental hotel. Please come directly to the 6th floor and check in with the guard, who will call me: 202 418 0920 or 202 391 4084.

-Richard

From: eitt líf koma nú griðastaðir [mailto:warren.havens@sbcglobal.net]
Sent: Monday, June 16, 2014 11:49 AM
To: Richard Arsenault
Cc: Jimmy Stobaugh
Subject: Re: Request for meeting Jn 16, 17, or 18 / Re: Questions re: 1) M-LMS order of this week. 2) dedicated AMTS for US passenger rail

Yes tomorrow at 11 am is good, thanks.
Where would I go for the meeting, and who may be there?
Can you give me an approximate length of time for the meeting so I can determine what to prepare?
- WH

From: Richard Arsenault <Richard.Arsenault@fcc.gov>
To: 'eitt líf koma nú griðastaðir' <warren.havens@sbcglobal.net>
Cc: Jimmy Stobaugh <jstobaugh@telesaurus.com>
Sent: Monday, June 16, 2014 11:08 AM
Subject: RE: Request for meeting Jn 16, 17, or 18 / Re: Questions re: 1) M-LMS order of this week. 2) dedicated AMTS for US passenger rail

Thank you Mr. Havens.

Please let me know if 11 AM Tuesday would work for you to discuss:

1. Private Commons
2. M-LMS
3. AMTS

From: eitt líf koma nú griðastaðir [mailto:warren.havens@sbcglobal.net]
Sent: Saturday, June 14, 2014 10:35 AM
To: Scot Stone; Richard Arsenault
Cc: Jimmy Stobaugh
Subject: Request for meeting Jn 16, 17, or 18 / Re: Questions re: 1) M-LMS order of this week. 2) dedicated AMTS for US passenger rail

Mr. Arsenault,
Re topic 1 based on M-LMS, below (email of 13th), would you have time next Monday or Tuesday, the 16th or 17th, or possibly Wednesday 18th, to meet me for a short discussion?
- I plan to be in DC from tomorrow for a few days, then returning to California.
- There are other related topics also, including our application for private commons, which the FCC has not responded to. Private commons applications are manual, and are a like a notice of a lease, but with leases, the FCC will accept them but we cannot get response to our private commons application
- (I assume you are the right person with whom to informally discuss this. If others, please let me know.)

Mr. Stone,
Re topic 2 based on AMTS, below (email of 13th), would you have time next Monday or Tuesday, the 16th or 17th, or possibly Wednesday 18th, to meet me for a short discussion?
- I plan to be in DC from tomorrow for a few days, then returning to California.
- There are other related topics also, including a possible application for private commons (but see above).
- (I assume you are the right person with whom to informally discuss this. If others, please let me know.)

Mr. Arsenault and Mr. Stone:
These two topics are related in my companies (including our nonprofit Foundation's) plans, as are our plans for our 35 and 43 MHz. The 900 MHz LMS, 200 MHz AMTS, and 35-43 MHz are each components of our nationwide plan for smart transport, energy, and other systems and environment monitoring and protection, for certain very sound technical, coverage and other reasons.

I wanted the "equal opportunity" to personally go over these, as is accommodated by FCC staff for most of other licensees with substantial spectrum and elements of new tech and market approaches. Given recent developments indicated in part by the topics 1 and 2 notes below, my companies and Foundation are now in a position to move forward whereas previously we were mostly blocked by incumbents in the 200 MHz, and by the long RM-NPRM in the 900 MHz.

3. Topic 3. Regarding our 35 and 43 MHz: could either of you suggest a person I could meet with on our plans, and potential relieve, for these licenses?

Regards,
Warren Havens

From: eitt líf koma nú griðastaðir <warren.havens@sbcglobal.net>
To: Richard Arsenault <Richard.Arsenault@fcc.gov>
Cc: Jimmy Stobaugh <jstobaugh@telesaurus.com>
Sent: Friday, June 13, 2014 3:55 PM
Subject: Re: Questions re: 1) M-LMS order of this week. 2) dedicated AMTS for US passenger rail

Mr. Arsenault,

To be safe, we will probably submit an additional filing soon. The Order does effect our case for renewal and an extension, as well as recent tech developments, and I have to exercise due diligence to get that in the official record of our licenses in case the requests are denied, so we have a better record for appeal.

Regards,
Warren Havens

ps. Any comments on the PTC spectrum idea I outlined?

From: Richard Arsenault <Richard.Arsenault@fcc.gov>
To: 'eitt líf koma nú griðastaðir' <warren.havens@sbcglobal.net>
Cc: Jimmy Stobaugh <jstobaugh@telesaurus.com>
Sent: Friday, June 13, 2014 2:24 PM
Subject: RE: Questions re: 1) M-LMS order of this week. 2) dedicated AMTS for US passenger rail

Mr. Havens

Regarding M-LMS, our aim is to act on the pending renewal and extension filings this summer. Staff has closely reviewed your filings and does not have any questions at this time.

Thank you.

From: eitt líf koma nú griðastaðir [mailto:warren.havens@sbcglobal.net]
Sent: Friday, June 13, 2014 11:53 AM
To: Richard Arsenault
Cc: Jimmy Stobaugh
Subject: Questions re: 1) M-LMS order of this week. 2) dedicated AMTS for US passenger rail

Mr. Arsenault,

Greetings again.
- I have several questions in case you can assist or point me to someone who can.
- I am on the East Coast and may visit DC next week, if I can extend my stay, and if so would try to find persons at the FCC to briefly discuss the following.

1. Re FCC 14-79: M-LMS Order terminating NPRM:
"... terminate the above-captioned Multilateration Location and Monitoring Service (M-LMS) rulemaking proceeding, and conclude that the various proposals for broad revisions of the applicable rules do not merit further consideration at this time."
- The Order essentially adopts the position that my companies advocated since this began. It began with RM-10403 in year 2003 which was later expanded in NPRM 06-49 in 2006. We advocated no change in the rules, since they were properly for ITS (the use and tech rules) and ITS was important, growing worldwide, etc.
- Since the rules were up in the air (for over *11 years* up to the Order), the FCC previously granted license construction deadline extensions, for all the LMS licensees. In the last one, a blanket extension, the FCC noted that while the extensions are for dates beyond the first-term of many of the LMS licenses, the licensees still had to submit renewal applications. My companies submitted timely renewals, years ago, and we submitted further requests to extend the construction deadlines for a number of years-- after the FCC decided on the NPRM, which has nor been done (adopting our basic position as noted above).

The issues I pose informally here are:

- We now want to update our renewal requests and extension requests, based on this Order, and that under the Order the rules will not be changed, which will allow us to proceed with technical, systems, and market plans leading to construction and operations, etc.
1. I would like to find out what time we will have to do that, prior to decisions on our renewals and extension requests.
2. Ideally, I would like to find out if the FCC intends to grant another blanket construction extension, based on this Order, or has any other actions in mind regarding my companies (or many LMS licensees) pending license renewal and extension requests. Our renewal and extension requests were much different than those of the other LMS licensees, thus, we seek decision on our particular requests, and after we update these (see item 1 above).

<u>2. Re PTC: approx. 100 kHz of AMTS, in a block, for US passenger trains</u>:
This is the topic in docket 11-79 (but the following is only an idea now):
- After certain litigation under antitrust law, our LLCs and Foundation that hold geographic AMTS B-block licenses (217-217.5 and 210-219.5 MHz) were able to get the licenses freed of same-block site-based licenses that had been asserted in most of the nation's major markets and corridors. This is shown in ULS records.
- In the meantime, we had various requests from passenger railroads to provide spectrum, and a few railroads are now engaged in communications for this purpose.
- I have been thinking that providing a 100 kHz or so block (that is all that is needed for PTC, especially if the spectrum is in a block that allows higher data rate, wider band, radios) nationwide for passenger trains (nationwide in the major markets that have passenger trains, and along corridors there there is substantial inter-city passenger trains).
- I may come to DC to talk with FTA and others that deal with passenger trains, to see if they have any interest in such an idea, and if they have any program or procedure to be involved. It makes sense since PTC systems have to inter operate, and the same block will allow that most fully, and the wider block (vs. separated narrow channels) offers far better upgrades, data rates, etc.
- My companies may dedicate spectrum for this purpose, at standard terms and procedures, and at well under market-rate prices, for sales and leases, that would be public.

The issues I pose informally here are:

1. Step 1. Assume that some passenger railroads, and a federal entity such as FTA, shows interest in this. Assume, with that showing, we design this program formally and publicly, and can present it in docket 11-79 if you- the FCC, find that useful (of course, others can "compete" as they want in such matters). If we do not get sufficient interest showings, then we would not proceed with Step 2.

2. Step 2. If we do get sufficient interest in Step 1, then we would ask the FCC to extend the current 10-year construction milestone for our AMTS licenses, based in part on this formal PTC-spectrum program. This had an FCC element that has been recently completed. We have other reasons also, to seek an extension, including (i) that our licenses were blocked for years in the major markets by certain site-based licenses, and we got evidence in the court case we brought to resolve the blockage (since we had evidence it was unlawful) that these were not in fact constructed and in service, leading to the clearance of these in a stipulated settlement, and (ii) new tech and equipment will be available soon, based on Digitial Radio Mondiale (and ETSI standard) in EU "Band III" which includes the US AMTS band: this is very spectrum efficient for one of our major planned uses of AMTS for smart transportation, by delivering N-RTK GPS corrections for very precise location and control of vehicles and vehicle flow. (iii) Other. These notes are informal (not a request for any FCC action) and are for purposes of the PTC component above.

Thank you,
Warren Havens

President - "SkyTel" companies: Skybridge Spectrum Foundation | Telesaurus Holdings GB LLC | ATLIS Wireless LLC | Environmentel LLC | Verde Systems LLC | Intelligent Transportation & Monitoring Wireless LLC | V2G LLC | Berkeley California | 510 841 2220 | 510 848 7797 - direct |

PUBLIC NOTICE

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DA 12-1344
Released: August 16, 2012

WIRELESS TELECOMMUNICATIONS BUREAU SEEKS COMMENT ON REQUESTS BY SKYBRIDGE SPECTRUM FOUNDATION AND TELESAURUS HOLDINGS GB, LLC FOR WAIVER AND EXTENSION OF TIME TO CONSTRUCT 900 MHZ MULTILATERATION LOCATION AND MONITORING SERVICE LICENSES

WT Docket 12-229

Comment Date: September 17, 2012
Reply Comment Date: October 2, 2012

By this *Public Notice*, the Wireless Telecommunications Bureau (Bureau) seeks comment on the requests for a waiver of Section 90.155(d) of the Commission's Rules[1] and extension of time filed by Telesaurus Holdings GB, LLC and Skybridge Spectrum Foundation in the Multilateration and Location and Monitoring Service (M-LMS) to meet their construction deadlines for their 900 MHz M-LMS Economic Area (EA) licenses.[2] Section 90.155(d) of the Commission's Rules requires M-LMS EA licensees either: (1) to construct and place in operation a sufficient number of base stations that utilize multilateration location service to one-third of the EA's population within five years of the initial license grant, and two-thirds of the population within ten years or, (2) in the alternative, to provide substantial service to their licensed area within the appropriate five- and ten-year benchmarks.[3] In an Order issued in November 2008, the Bureau extended these construction requirements for Telesaurus, Skybridge, and four other M-LMS licensees, requiring these licensees to meet the five-year construction requirement on or before July 19, 2012, and the ten-year requirement on or before July 19, 2014.[4]

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[1] 47 C.F.R. § 90.155(d).

[2] *See* Telesaurus Holdings GB, LLC (Telesaurus) Request for Extension of Time (filed July 18, 2012) (Telesaurus Waiver Request); Skybridge Spectrum Foundation (Skybridge) Request for Extension of Time (filed July 18, 2012) (Skybridge Waiver Request). The Attachments to this *Public Notice* list the related Universal Licensing System (ULS) file numbers. The call signs and EA's for which Telesaurus and Skybridge request a waiver are also listed in the Attachments to this *Public Notice.*

[3] *See* 47 C.F.R. § 90.155(d).

[4] *See* Requests of Progeny LMS, LLC and PCS Partners, L.P. for Waiver of Multilateration Location and Monitoring Service Construction Rules, *Order*, 23 FCC Rcd 17250 (WTB 2008) (*M-LMS Extension Order*). In the 2008 order, the Bureau extended the five-year construction requirement to July 19, 2012 only for licensees required to meet the deadline on or before July 19, 2012. The Bureau extended the ten-year construction requirement only for licensees required to meet the deadline on or before July 19, 2014. *See id.* at ¶¶ 1, 21. On July 17, 2012, the Bureau released a public notice seeking comment on requests for waiver and extension of time to construct M-LMS licenses filed by four other M-LMS licensees. *See* Wireless Telecommunications Bureau Seeks Comment on Requests by Progeny LMS, LLC, FCR, Inc., Helen Wong-Armijo, and PCS Partners, L.P. for Waiver and Extension of Time to Construct 900 MHz Multilateration Location and Monitoring Service Licenses, *Public Notice,* DA 12-1144 (WTB 2012).

Telesaurus and Skybridge (Applicants) seek preferred extension terms and propose two alternatives for an extension of the buildout deadlines for 257 M-LMS licenses covering 129 EA's.[5] First, as a "Preferred Alternative," Applicants seek an extension for both their first and second buildout deadlines until ten years after final Commission action on the rule changes proposed in the pending Notice of Proposed Rulemaking addressing M-LMS regulations,[6] or until December 31, 2022, if a date certain must be chosen.[7] Applicants state that if the Preferred Alternative were granted, they would file a due diligence report five years after final action on the *M-LMS NPRM*.[8] As a second alternative, Applicants seek an extension of the first buildout deadline until five years after final Commission action on the rule changes proposed in the LMS NPRM, or if the Applicants must chose a date certain, five years from the last day of this current year (December 31, 2017).[9] As a third alternative, Applicants request that the Commission grant whatever additional time it determines to be reasonable to meet the first and second buildout deadlines.[10]

Applicants state the Skybridge Waiver Request should be granted for the same reasons the Bureau relied on in the *M-LMS Extension Order*.[11] The Applicants state that the circumstances remain essentially the same, including the lack of M-LMS equipment and the regulatory uncertainty created by the pending LMS NPRM.[12]

Applicants explain that they plan to use Long Term Evolution (LTE) for M-LMS communications and that LTE is in the early stage of developments and deployments worldwide.[13] Applicants plan to deploy a M-LMS LTE system nationwide for Intelligent Transportation Systems (ITS) in conjunction with several thousand licenses they have obtained in the 35, 43, 217-220 MHz (and adjacent) and other (non-M-LMS) 900 MHz bands.[14] Applicants state that the use of these frequency ranges will provide the following benefits in the public interest: (a) quicker and more complete nationwide coverage; (b) coverage and communications location link redundancies, increasing reliability and safety; (c) more cost effective expenditures; (d) better support of the public safety by providing preemption of substantial amounts of capacity in emergencies; and (e) "better support of and use of [Dedicated Short Range Communications] DSRC spectrum and systems for ITS (DSRC can provide final

[5] Telesaurus states that it does not have a construction obligation for its 129 M-LMS licenses as a result of a partial assignment of 128 licenses to Skybridge consummated on August 9, 2007, and the application for partial assignment of call sign WQGN602, filed July 18, 2012. However, Telesaurus states that it seeks identical relief sought by Skybridge in the case that the FCC finds construction requirements apply to these licenses. *See* Telesaurus Waiver Request at 1; ULS File No. 0005315596 (filed July 18, 2012).

[6] *See* Amendment of the Commission's Part 90 Rules in the 904-909.75 and 919.75-928 MHz Bands, *Notice of Proposed Rulemaking,* 21 FCC Rcd 2809 (2006) (*M-LMS NPRM*).

[7] *See* Skybridge Waiver Request at 2. The Applicants refer to this request as the "Preferred Alternative." Telesaurus and Skybridge note that for purposes of the extension request statement on Form 601, which requires a date certain, Applicants use a date based on its Preferred Alternative, assuming that the *M-LMS NPRM* is decided upon at the end of 2012. *Id.*

[8] *Id.*

[9] *See* Skybridge Waiver Request at 1-2.

[10] *See id.* at 4.

[11] *See id.* at 7.

[12] *See id*.

[13] *See id.* at 2.

[14] *See id.* at n.3; 3.

links, in many cases, to vehicles and things in ITS systems, but by itself does not have sufficient coverage-distance and- [sic] reliability capability…).”[15]

Applicants claim that they have performed substantial due diligence to enable construction and operation of the subject M-LMS licenses for highly valuable services.[16] In support of this statement, Applicants attached a number of exhibits, including papers by Dr. Nishith Tripathi and Kostantinos Trichias, explaining that there is a very strong case for the use of LTE for M-LMS to provide wide-area ITS radio systems.[17] Further, Applicants state their due diligence includes: (1) investigating and developing advanced, standards-based technology and equipment, including LTE, with integrated multilateration technology; and (2) investigations, surveys, and development for nationwide construction and operation of the noted M-LMS systems for ITS applications.[18]

Procedural Matters

Comments on the request are due **no later than September 17, 2012**. Reply comments are due **no later than October 2, 2012**. All filings should reference the docket number of this proceeding, **WT 12-229.**

This proceeding has been designated as a “permit-but-disclose” proceeding in accordance with the Commission's *ex parte* rules.[19] Persons making *ex parte* presentations must file a copy of any written presentation or a memorandum summarizing any oral presentation within two business days after the presentation (unless a different deadline applicable to the Sunshine period applies). Persons making oral *ex parte* presentations are reminded that memoranda summarizing the presentation must (1) list all persons attending or otherwise participating in the meeting at which the *ex parte* presentation was made, and (2) summarize all data presented and arguments made during the presentation. If the presentation consisted in whole or in part of the presentation of data or arguments already reflected in the presenter’s written comments, memoranda or other filings in the proceeding, the presenter may provide citations to such data or arguments in his or her prior comments, memoranda, or other filings (specifying the relevant page and/or paragraph numbers where such data or arguments can be found) in lieu of summarizing them in the memorandum. Documents shown or given to Commission staff during *ex parte* meetings are deemed to be written *ex parte* presentations and must be filed consistent with rule 1.1206(b). In proceedings governed by rule 1.49(f) or for which the Commission has made available a method of electronic filing, written *ex parte* presentations and memoranda summarizing oral *ex parte* presentations, and all attachments thereto, must be filed through the electronic comment filing system available for that proceeding, and must be filed in their native format (*e.g.*, .doc, .xml, .ppt, searchable .pdf). Participants in this proceeding should familiarize themselves with the Commission’s *ex parte* rules.

Comments may be filed using the Commission's Electronic Comment Filing System (ECFS) or by filing paper copies. *See* Electronic Filing of Documents in Rulemaking Proceedings, 63 Fed. Reg. 24121 (1998). Comments filed through the ECFS can be sent as an electronic file via the Internet to http:// www.fcc.gov/cgb/ecfs/. Generally, only one copy of an electronic submission must be filed. If multiple docket or rulemaking numbers appear in the caption of this proceeding, however, commenters must transmit one electronic copy of the comments to each docket or rulemaking number referenced in the caption. In completing the transmittal screen, commenters should include their full name, U.S. Postal

[15] Skybridge Waiver Request at 4.

[16] *See id.* at 5-6.

[17] *Id. See, e.g.,* ULS File No. 0005315741, Attachments (Attachment 2, Exhibit List, Exhibit 3, Exhibit 4 from Skybridge) (filed Jul. 18, 2012); ULS File No. 0005317957, Attachments (Exhibits A-D, Extension Request-Supplement from Skybridge) (filed Jul. 19, 2012).

[18] *See* Skybridge Waiver Request at 5.

[19] *See* 47 C.F.R. §§ 1.1200(a), 1.1206.

Service mailing address, and the applicable docket or rulemaking number. Parties may also submit an electronic comment by Internet e-mail. To get filing instructions for e-mail comments, commenters should send an e-mail to ecfs@fcc.gov, and should include the following words in the body of the message, "get form." A sample form and directions will be sent in reply.

Parties who choose to file by paper must file an original and one copy of each filing. If more than one docket or rulemaking number appears in the caption of this proceeding, commenters must submit two additional copies for each additional docket or rulemaking number.

Filings can be sent by hand or messenger delivery, by commercial overnight courier, or by first-class or overnight U.S. Postal Service mail (although we continue to experience delays in receiving U.S. Postal Service mail). All filings must be addressed to the Commission's Secretary, Office of the Secretary, Federal Communications Commission.

-Effective December 28, 2009, all hand-delivered paper filings for the Commission's Secretary must be delivered to FCC Headquarters at 445 12th St., S.W., Room TW-A325, Washington, DC 20554. All hand deliveries must be held together with rubber bands or fasteners. Envelopes must be disposed of before entering the building. The filing hours at this location are 8:00 a.m. to 7:00 p.m. **PLEASE NOTE:** The Commission's former filing location at 236 Massachusetts Ave., N.E. is permanently closed.

-Commercial overnight mail (other than U.S. Postal Service Express Mail and Priority Mail) must be sent to 9300 East Hampton Drive, Capitol Heights, MD 20743.

-U.S. Postal Service first-class mail, Express Mail, and Priority Mail should be addressed to 445 12th Street, S.W., Washington, DC 20554.

Parties are requested to send one copy of their comments and reply comments to Best Copy and Printing, Inc., Portals II, 445 12th Street, S.W., Room CY-B402, Washington, DC 20554, (800) 378-3160, e-mail FCC@BCPIWEB.com.

The request, and comments and reply comments filed in response to this *Public Notice* are available for viewing via the Commission's Electronic Comment Filing System (ECFS) by entering the docket number, **WT 12-229**. The documents also will be available for public inspection and copying during business hours in the FCC Reference Information Center, Portals II, 445 12th Street S.W., Room CY-A257, Washington, DC 20554. They may also be purchased from Best Copy and Printing, Inc., telephone (800) 378-3160, facsimile (202) 488-5563, TTY (202) 488-5562, e-mail FCC@BCPIWEB.com.

Alternate formats of this *Public Notice* (computer diskette, large print, audio recording, and Braille) are available to persons with disabilities by contacting the Consumer & Governmental Affairs Bureau at (202) 418-0530 (voice), (202) 418-0432 (TTY), or send an e-mail to fcc504@fcc.gov.

For further information, contact Ms. Becky Schwartz of the Mobility Division, Wireless Telecommunications Bureau at (202) 418-7178, or via e-mail at Becky.Schwartz@fcc.gov.

Action by the Chief, Mobility Division, Wireless Telecommunications Bureau.

- FCC -

ATTACHMENT A

FILE NUMBERS, CALLSIGNS, MARKET CODES, MARKET DESCRIPTIONS, AND CHANNEL BLOCKS FOR WHICH WAIVER OF 90.155(D) IS REQUESTED BY SKYBRIDGE

File Number	Call Sign	Market Designator	Market Name	Channel Block
0005315615	WQHU548	BEA003	Boston-Worcester-Lawrence-Lowe	A
0005315616	WQHU549	BEA010	New York-No. New Jer.-Long Isl	A
0005315617	WQHU550	BEA012	Philadelphia-Wilmington-Atl. C	A
0005315618	WQHU551	BEA013	Washington-Baltimore, DC-MD-VA	A
0005315619	WQHU552	BEA015	Richmond-Petersburg, VA	A
0005315620	WQHU553	BEA018	Greensboro-Winston-Salem-High	A
0005315621	WQHU554	BEA019	Raleigh-Durham-Chapel Hill, NC	A
0005315622	WQHU555	BEA023	Charlotte-Gastonia-Rock Hill,	A
0005315623	WQHU556	BEA024	Columbia, SC	A
0005315624	WQHU557	BEA028	Savannah, GA-SC	A
0005315625	WQHU558	BEA029	Jacksonville, FL-GA	A
0005315626	WQHU559	BEA030	Orlando, FL	A
0005315627	WQHU560	BEA031	Miami-Fort Lauderdale, FL	A
0005315628	WQHU561	BEA032	Fort Myers-Cape Coral, FL	A
0005315629	WQHU562	BEA033	Sarasota-Bradenton, FL	A
0005315630	WQHU563	BEA035	Tallahassee, FL-GA	A
0005315631	WQHU564	BEA041	Greenville-Spartanburg-Anderso	A
0005315632	WQHU565	BEA047	Lexington, KY-TN-VA-WV	A
0005315633	WQHU566	BEA057	Detroit-Ann Arbor-Flint, MI	A
0005315634	WQHU567	BEA063	Milwaukee-Racine, WI	A
0005315635	WQHU568	BEA064	Chicago-Gary-Kenosha, IL-IN-WI	A
0005315636	WQHU569	BEA071	Nashville, TN-KY	A
0005315637	WQHU570	BEA073	Memphis, TN-AR-MS-KY	A
0005315638	WQHU571	BEA077	Jackson, MS-AL-LA	A
0005315639	WQHU572	BEA079	Montgomery, AL	A
0005315640	WQHU573	BEA080	Mobile, AL	A
0005315641	WQHU574	BEA083	New Orleans, LA-MS	A
0005315642	WQHU575	BEA084	Baton Rouge, LA-MS	A
0005315643	WQHU576	BEA090	Little Rock-North Little Rock,	A
0005315644	WQHU577	BEA127	Dallas-Fort Worth, TX-AR-OK	A
0005315645	WQHU578	BEA130	Austin-San Marcos, TX	A
0005315646	WQHU579	BEA131	Houston-Galveston-Brazoria, TX	A
0005315647	WQHU580	BEA134	San Antonio, TX	A
0005315648	WQHU581	BEA143	Casper, WY-ID-UT	A
0005315649	WQHU582	BEA141	Denver-Boulder-Greeley, CO-KS-	A
0005315650	WQHU583	BEA147	Spokane, WA-ID	A

0005315651	WQHU584	BEA148	Idaho Falls, ID-WY	A
0005315652	WQHU585	BEA149	Twin Falls, ID	A
0005315653	WQHU586	BEA150	Boise City, ID-OR	A
0005315654	WQHU587	BEA151	Reno, NV-CA	A
0005315655	WQHU588	BEA152	Salt Lake City-Ogden, UT-ID	A
0005315656	WQHU589	BEA154	Flagstaff, AZ-UT	A
0005315657	WQHU590	BEA156	Albuquerque, NM-AZ	A
0005315658	WQHU591	BEA158	Phoenix-Mesa, AZ-NM	A
0005315659	WQHU592	BEA159	Tucson, AZ	A
0005315660	WQHU593	BEA160	Los Angeles-Riverside-Orange C	A
0005315661	WQHU594	BEA161	San Diego, CA	A
0005315662	WQHU595	BEA162	Fresno, CA	A
0005315663	WQHU596	BEA163	San Francisco-Oakland-San Jose	A
0005315664	WQHU597	BEA166	Eugene-Springfield, OR-CA	A
0005315665	WQHU598	BEA167	Portland-Salem, OR-WA	A
0005315666	WQHU599	BEA170	Seattle-Tacoma-Bremerton, WA	A
0005315667	WQHU600	BEA009	State College, PA	A
0005315668	WQHU601	BEA011	Harrisburg-Lebanon-Carlisle, P	A
0005315669	WQHU602	BEA014	Salisbury, MD-DE-VA	A
0005315670	WQHU603	BEA016	Staunton, VA-WV	A
0005315671	WQHU604	BEA017	Roanoke, VA-NC-WV	A
0005315672	WQHU605	BEA021	Greenville, NC	A
0005315673	WQHU606	BEA027	Augusta-Aiken, GA-SC	A
0005315674	WQHU607	BEA036	Dothan, AL-FL-GA	A
0005315675	WQHU608	BEA037	Albany, GA	A
0005315676	WQHU609	BEA038	Macon, GA	A
0005315677	WQHU610	BEA039	Columbus, GA-AL	A
0005315678	WQHU611	BEA043	Chattanooga, TN-GA	A
0005315679	WQHU612	BEA044	Knoxville, TN	A
0005315680	WQHU613	BEA053	Pittsburgh, PA-WV	A
0005315681	WQHU614	BEA056	Toledo, OH	A
0005315682	WQHU615	BEA066	Fort Wayne, IN	A
0005315683	WQHU616	BEA068	Champaign-Urbana, IL	A
0005315684	WQHU617	BEA069	Evansville-Henderson, IN-KY-IL	A
0005315685	WQHU618	BEA072	Paducah, KY-IL	A
0005315686	WQHU619	BEA076	Greenville, MS	A
0005315687	WQHU620	BEA078	Birmingham, AL	A
0005315688	WQHU621	BEA081	Pensacola, FL	A
0005315689	WQHU622	BEA082	Biloxi-Gulfport-Pascagoula, MS	A
0005315690	WQHU623	BEA088	Shreveport-Bossier City, LA-AR	A
0005315691	WQHU624	BEA089	Monroe, LA	A

0005315692	WQHU625	BEA091	Fort Smith, AR-OK	A
0005315693	WQHU626	BEA092	Fayetteville-Springdale-Rogers	A
0005315694	WQHU627	BEA094	Springfield, MO	A
0005315695	WQHU628	BEA095	Jonesboro, AR-MO	A
0005315696	WQHU629	BEA098	Columbia, MO	A
0005315697	WQHU630	BEA101	Peoria-Pekin, IL	A
0005315698	WQHU631	BEA102	Davenport-Moline-Rock Island,	A
0005315699	WQHU632	BEA103	Cedar Rapids, IA	A
0005315700	WQHU633	BEA121	North Platte, NE-CO	A
0005315701	WQHU634	BEA128	Abilene, TX	A
0005315702	WQHU635	BEA129	San Angelo, TX	A
0005315703	WQHU636	BEA136	Hobbs, NM-TX	A
0005315704	WQHU637	BEA137	Lubbock, TX	A
0005315705	WQHU638	BEA138	Amarillo, TX-NM	A
0005315706	WQHU639	BEA142	Scottsbluff, NE-WY	A
0005315707	WQHU640	BEA172	Honolulu, HI	A
0005315708	WQHU641	BEA174	Puerto Rico & Virgin Isl.	A
0005315709	WQHU642	BEA176	Gulf of Mexico	A
0005315710	WQHU643	BEA004	Burlington, VT-NY	A
0005315711	WQHU644	BEA058	Northern Michigan, MI	A
0005315712	WQHU645	BEA065	Elkhart-Goshen, IN-MI	A
0005315713	WQHU646	BEA075	Tupelo, MS-AL-TN	A
0005315714	WQHU647	BEA085	Lafayette, LA	A
0005315715	WQHU648	BEA086	Lake Charles, LA	A
0005315716	WQHU649	BEA093	Joplin, MO-KS-OK	A
0005315717	WQHU650	BEA100	Des Moines, IA-IL-MO	A
0005315718	WQHU651	BEA110	Grand Forks, ND-MN	A
0005315719	WQHU652	BEA111	Minot, ND	A
0005315720	WQHU653	BEA112	Bismarck, ND-MT-SD	A
0005315721	WQHU654	BEA113	Fargo-Moorhead, ND-MN	A
0005315722	WQHU655	BEA114	Aberdeen, SD	A
0005315723	WQHU656	BEA115	Rapid City, SD-MT-ND-NE	A
0005315724	WQHU657	BEA116	Sioux Falls, SD-IA-MN-NE	A
0005315725	WQHU658	BEA117	Sioux City, IA-NE-SD	A
0005315726	WQHU659	BEA118	Omaha, NE-IA-MO	A
0005315727	WQHU660	BEA119	Lincoln, NE	A
0005315728	WQHU661	BEA120	Grand Island, NE	A
0005315729	WQHU662	BEA122	Wichita, KS-OK	A
0005315730	WQHU663	BEA123	Topeka, KS	A
0005315731	WQHU664	BEA124	Tulsa, OK-KS	A
0005315732	WQHU665	BEA126	Western Oklahoma, OK	A

0005315733	WQHU666	BEA139	Santa Fe, NM	A
0005315734	WQHU667	BEA140	Pueblo, CO-NM	A
0005315735	WQHU668	BEA144	Billings, MT-WY	A
0005315736	WQHU669	BEA145	Great Falls, MT	A
0005315737	WQHU670	BEA146	Missoula, MT	A
0005315738	WQHU671	BEA155	Farmington, NM-CO	A
0005315739	WQHU672	BEA165	Redding, CA-OR	A
0005315740	WQHU673	BEA168	Pendleton, OR-WA	A
0005315741	WQHU674	BEA169	Richland-Kennewick-Pasco, WA	A
0005315742	WQHU675	BEA171	Anchorage, AK	A

ATTACHMENT B

FILE NUMBERS, CALLSIGNS, MARKET CODES, MARKET DESCRIPTIONS, AND CHANNEL BLOCKS FOR WHICH WAIVER OF 90.155(D) IS REQUESTED BY TELESAURUS

File Number	Call Sign	Market Designator	Market Name	Channel Block
0005315744	WPOJ876	BEA003	Boston-Worcester-Lawrence-Lowe	A
0005315745	WPOJ877	BEA010	New York-No. New Jer.-Long Isl	A
0005315746	WPOJ878	BEA012	Philadelphia-Wilmington-Atl. C	A
0005315747	WPOJ879	BEA013	Washington-Baltimore, DC-MD-VA	A
0005315748	WPOJ880	BEA015	Richmond-Petersburg, VA	A
0005315749	WPOJ881	BEA018	Greensboro-Winston-Salem-High	A
0005315750	WPOJ882	BEA019	Raleigh-Durham-Chapel Hill, NC	A
0005315751	WPOJ883	BEA023	Charlotte-Gastonia-Rock Hill,	A
0005315752	WPOJ884	BEA024	Columbia, SC	A
0005315753	WPOJ885	BEA028	Savannah, GA-SC	A
0005315754	WPOJ886	BEA029	Jacksonville, FL-GA	A
0005315755	WPOJ887	BEA030	Orlando, FL	A
0005315756	WPOJ888	BEA031	Miami-Fort Lauderdale, FL	A
0005315757	WPOJ889	BEA032	Fort Myers-Cape Coral, FL	A
0005315758	WPOJ890	BEA033	Sarasota-Bradenton, FL	A
0005315759	WPOJ891	BEA035	Tallahassee, FL-GA	A
0005315760	WPOJ892	BEA041	Greenville-Spartanburg-Anderso	A
0005315761	WPOJ893	BEA047	Lexington, KY-TN-VA-WV	A
0005315762	WPOJ894	BEA057	Detroit-Ann Arbor-Flint, MI	A
0005315763	WPOJ895	BEA063	Milwaukee-Racine, WI	A
0005315764	WPOJ896	BEA064	Chicago-Gary-Kenosha, IL-IN-WI	A
0005315765	WPOJ897	BEA071	Nashville, TN-KY	A
0005315766	WPOJ898	BEA073	Memphis, TN-AR-MS-KY	A
0005315767	WPOJ899	BEA077	Jackson, MS-AL-LA	A
0005315768	WPOJ900	BEA079	Montgomery, AL	A
0005315769	WPOJ901	BEA080	Mobile, AL	A
0005315770	WPOJ902	BEA083	New Orleans, LA-MS	A
0005315771	WPOJ903	BEA084	Baton Rouge, LA-MS	A
0005315772	WPOJ904	BEA090	Little Rock-North Little Rock,	A
0005315773	WPOJ905	BEA127	Dallas-Fort Worth, TX-AR-OK	A
0005315774	WPOJ906	BEA130	Austin-San Marcos, TX	A
0005315775	WPOJ907	BEA131	Houston-Galveston-Brazoria, TX	A
0005315776	WPOJ908	BEA134	San Antonio, TX	A
0005315777	WPOJ909	BEA141	Denver-Boulder-Greeley, CO-KS-	A
0005315778	WPOJ910	BEA143	Casper, WY-ID-UT	A

0005315779	WPOJ911	BEA147	Spokane, WA-ID	A
0005315780	WPOJ912	BEA148	Idaho Falls, ID-WY	A
0005315781	WPOJ913	BEA149	Twin Falls, ID	A
0005315782	WPOJ914	BEA150	Boise City, ID-OR	A
0005315783	WPOJ915	BEA151	Reno, NV-CA	A
0005315784	WPOJ916	BEA152	Salt Lake City-Ogden, UT-ID	A
0005315785	WPOJ917	BEA154	Flagstaff, AZ-UT	A
0005315786	WPOJ918	BEA156	Albuquerque, NM-AZ	A
0005315787	WPOJ919	BEA158	Phoenix-Mesa, AZ-NM	A
0005315788	WPOJ920	BEA159	Tucson, AZ	A
0005315789	WPOJ921	BEA160	Los Angeles-Riverside-Orange C	A
0005315790	WPOJ922	BEA161	San Diego, CA	A
0005315791	WPOJ923	BEA162	Fresno, CA	A
0005315792	WPOJ924	BEA163	San Francisco-Oakland-San Jose	A
0005315793	WPOJ925	BEA166	Eugene-Springfield, OR-CA	A
0005315794	WPOJ926	BEA167	Portland-Salem, OR-WA	A
0005315795	WPOJ927	BEA170	Seattle-Tacoma-Bremerton, WA	A
0005315796	WPTH910	BEA009	State College, PA	A
0005315797	WPTH911	BEA011	Harrisburg-Lebanon-Carlisle, P	A
0005315798	WPTH912	BEA014	Salisbury, MD-DE-VA	A
0005315799	WPTH913	BEA016	Staunton, VA-WV	A
0005315800	WPTH914	BEA017	Roanoke, VA-NC-WV	A
0005315801	WPTH915	BEA021	Greenville, NC	A
0005315802	WPTH916	BEA027	Augusta-Aiken, GA-SC	A
0005315803	WPTH917	BEA036	Dothan, AL-FL-GA	A
0005315804	WPTH918	BEA037	Albany, GA	A
0005315805	WPTH919	BEA038	Macon, GA	A
0005315806	WPTH920	BEA039	Columbus, GA-AL	A
0005315807	WPTH921	BEA043	Chattanooga, TN-GA	A
0005315808	WPTH922	BEA044	Knoxville, TN	A
0005315809	WPTH923	BEA053	Pittsburgh, PA-WV	A
0005315810	WPTH924	BEA056	Toledo, OH	A
0005315811	WPTH925	BEA066	Fort Wayne, IN	A
0005315812	WPTH926	BEA068	Champaign-Urbana, IL	A
0005315813	WPTH927	BEA069	Evansville-Henderson, IN-KY-IL	A
0005315814	WPTH928	BEA072	Paducah, KY-IL	A
0005315815	WPTH929	BEA076	Greenville, MS	A
0005315816	WPTH930	BEA078	Birmingham, AL	A
0005315817	WPTH931	BEA081	Pensacola, FL	A
0005315818	WPTH932	BEA082	Biloxi-Gulfport-Pascagoula, MS	A
0005315819	WPTH933	BEA088	Shreveport-Bossier City, LA-AR	A

0005315820	WPTH934	BEA089	Monroe, LA	A
0005315821	WPTH935	BEA091	Fort Smith, AR-OK	A
0005315822	WPTH936	BEA092	Fayetteville-Springdale-Rogers	A
0005315823	WPTH938	BEA094	Springfield, MO	A
0005315824	WPTH939	BEA095	Jonesboro, AR-MO	A
0005315825	WPTH940	BEA098	Columbia, MO	A
0005315826	WPTH941	BEA101	Peoria-Pekin, IL	A
0005315827	WPTH942	BEA102	Davenport-Moline-Rock Island,	A
0005315828	WPTH943	BEA103	Cedar Rapids, IA	A
0005315829	WPTH944	BEA121	North Platte, NE-CO	A
0005315830	WPTH945	BEA128	Abilene, TX	A
0005315831	WPTH946	BEA129	San Angelo, TX	A
0005315832	WPTH947	BEA136	Hobbs, NM-TX	A
0005315833	WPTH948	BEA137	Lubbock, TX	A
0005315834	WPTH949	BEA138	Amarillo, TX-NM	A
0005315835	WPTH950	BEA142	Scottsbluff, NE-WY	A
0005315836	WPTH951	BEA172	Honolulu, HI	A
0005315837	WPTH952	BEA174	Puerto Rico & Virgin Isl.	A
0005315838	WPTH953	BEA176	Gulf of Mexico	A
0005315839	WQGN573	BEA004	Burlington, VT-NY	A
0005315840	WQGN574	BEA058	Northern Michigan, MI	A
0005315841	WQGN575	BEA065	Elkhart-Goshen, IN-MI	A
0005315842	WQGN576	BEA075	Tupelo, MS-AL-TN	A
0005315843	WQGN577	BEA085	Lafayette, LA	A
0005315844	WQGN578	BEA086	Lake Charles, LA	A
0005315845	WQGN579	BEA093	Joplin, MO-KS-OK	A
0005315846	WQGN580	BEA100	Des Moines, IA-IL-MO	A
0005315847	WQGN581	BEA110	Grand Forks, ND-MN	A
0005315848	WQGN582	BEA111	Minot, ND	A
0005315849	WQGN583	BEA112	Bismarck, ND-MT-SD	A
0005315850	WQGN584	BEA113	Fargo-Moorhead, ND-MN	A
0005315851	WQGN585	BEA114	Aberdeen, SD	A
0005315852	WQGN586	BEA115	Rapid City, SD-MT-ND-NE	A
0005315853	WQGN587	BEA116	Sioux Falls, SD-IA-MN-NE	A
0005315854	WQGN588	BEA117	Sioux City, IA-NE-SD	A
0005315855	WQGN589	BEA118	Omaha, NE-IA-MO	A
0005315856	WQGN590	BEA119	Lincoln, NE	A
0005315857	WQGN591	BEA120	Grand Island, NE	A
0005315858	WQGN592	BEA122	Wichita, KS-OK	A
0005315859	WQGN593	BEA123	Topeka, KS	A
0005315860	WQGN594	BEA124	Tulsa, OK-KS	A

0005315861	WQGN595	BEA126	Western Oklahoma, OK	A
0005315862	WQGN596	BEA139	Santa Fe, NM	A
0005315863	WQGN597	BEA140	Pueblo, CO-NM	A
0005315864	WQGN598	BEA144	Billings, MT-WY	A
0005315865	WQGN599	BEA145	Great Falls, MT	A
0005315866	WQGN600	BEA146	Missoula, MT	A
0005315867	WQGN601	BEA155	Farmington, NM-CO	A
0005315868	WQGN602	BEA164	Sacramento-Yolo, CA	C
0005315869	WQGN603	BEA165	Redding, CA-OR	A
0005315870	WQGN604	BEA168	Pendleton, OR-WA	A
0005315871	WQGN605	BEA169	Richland-Kennewick-Pasco, WA	A
0005315872	WQGN606	BEA171	Anchorage, AK	A

Skytel entities, via W. Havens.

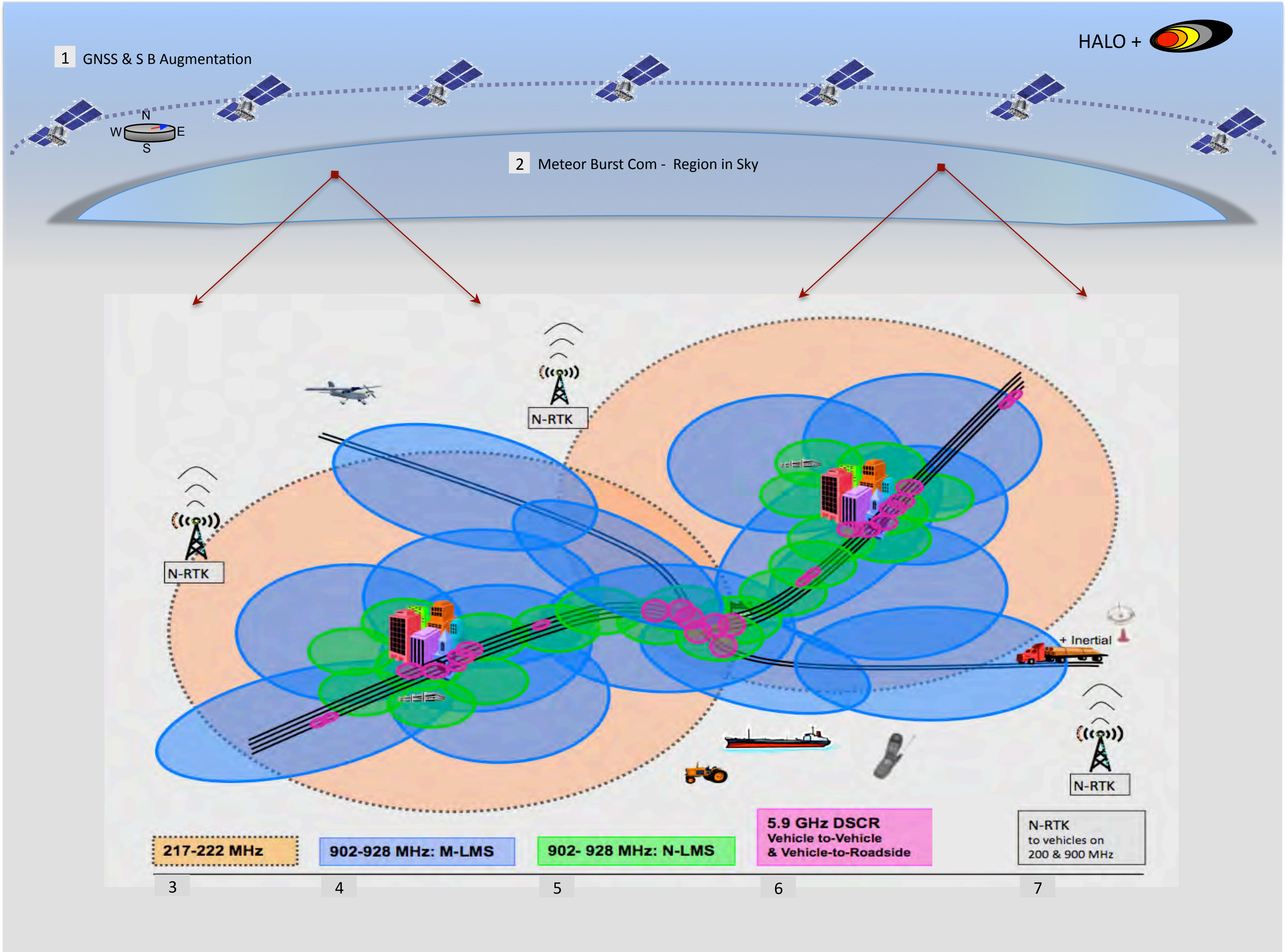
FCC meeting June 17, 2014 - handout

HALO+
High accuracy location+

1	Network Architecture & Plan	
2	M-LMS	
3	AMTS	
4	Low VHF	
5	Renewals and construction-service extensions	
6	Federal agencies, Congress, public-private	
7	Private commons, and other	

HALO +

1 Network Architecture & Plan



1 GNSS & S B Augmentation
HALO +
N
W
E
S
2 Meteor Burst Com - Region in Sky
N-RTK
N-RTK
+ Inertial
N-RTK
217-222 MHz
902-928 MHz: M-LMS
902- 928 MHz: N-LMS
5.9 GHz DSCR
Vehicle to-Vehicle
& Vehicle-to-Roadside
N-RTK
to vehicles on
200 & 900 MHz
3
4
5
6
7

More Aggressive-1 WTDY (**WORST** time day and year) configuration using the MBC network estimation tool, v1.8, by Robert Mawrey, PhD for SkyTel.
Must read WH Notes on a page below and discuss with me to understand how to assess this . *Other configuration results on subsequent pages below.*

ZOOM to 200% or more, ideally on wide screen.

	A	B	C	D	E	F	G	H	I	J
1	*[WH: MUST READ: This models only the use of one 250 kHz wide channel. See WH notes below as to use of wider, or additional, channels, and other critical notes for understanding this and other runs using this current " v. 1.8(wh)".]*									
2	**RESULTS**	**Value**	**Unit**			**Notes**				
3	Estimated Remote Link Short Message Wait Time (Average) [see WH note below]	33.09	Seconds			For a single master and single remote	11.0289	0.55145	108.805	
4	Estimated Remote Link Short Message Wait Time 0th Percentile	#NAME?	#NAME?			[This function not yet activated: needs Mac Version of SimTools.xlam or equal.]				#NAME?
5	Estimated Remote Link Throughput	2,434	bps			For a single master and single remote	3	7302		
6	Estimated Remote Link Short Message Wait Time ***with diversity***	1.42	Seconds				3			
7	Estimated Remote Link Short Message Wait Time with diversity 0th Percentile	#NAME?	#NAME?			[This function not yet activated: needs Mac Version of SimTools.xlam or equal.]				
8	Estimated Remote Link Throughput ***with Diversity***	567,524	bps							
10	*[WH: "This MASTER section, & related items below, assumes existing Yagi antennas, but I plan Metamaterials-Fractal Antennas & smart phased arrays, which, per literature on these, should allow better performance, less transmit power, less components & size & cost.]*									
11	**MASTER**									
12	Required master station power per sector per channel	10,437	Watts			For Remote link reciprocity				
13	Master Station ERP	1,314,002	Watts							
14	Required master station power per sector	104,375	Watts							
15	Total output power per master station	6,575,617	Watts							
16	Number of sectors required	63								
17	Total number of antennas per master station	315								
18	**Input Parameter**	**Input Values (White)**	**Reference Values**	**Unit**	**Gain relative to ref. system (dB)**	**Notes**	Temp1	Temp2	Temp3	
19	Frequency	40	46	MHz	0.5	Factors in frequency gain (10*LOG((46/B2)^3)) and cosmic noise (-9.554*LN(B2) + 51)				
20	Bandwidth	1000	25	kHz		Meteor burst channel bandwidth				
21	Coding Gain	10.0	0	dB	10.0	Gain Relative to no coding for Cognitive Radio with Good codes				
22	Number of Channels	10				Number of channels per master sector. Power increased for each channel.				
23	Adaptive Data or Coding throughput improvement	1.5	1	Factor	1.5	Broadcast mode can only be 1 *[WH: with MB radar, needed for MB PNT, broadcast probably can get info for adaptive data]*.				
24	Wait-time Percentile					Confidence that the message will be received. [This function not yet activated: needs Mac Version of SimTools.xlam or equal.]				
25	Data Rate	2,000	2,000	bps						
26	Area of the continental USA	8,080,464		square km						
27	Remote System gain relative to the reference system				22.2					
28	Message Length	40	40	Characters		320 bits				
29	Hemisphere	Northern								
30	Time of Day [17:00 is worst, and 6:00 is best.]		17:00				1.00342			
31	Month of Year [Feb-Mar is worst, and Jl-Aug is best (good for farmers, etc.)]		Feb			See curve on Yearly tab	1.0			
33	**MASTER** *[see WH notes below]*									
34	Required master station power per sector per channel	10,437	1,000	Watts	10.2	For Remote link reciprocity	40.186	10437.5		
35	Master Station ERP	1,314,002		Watts						
36	Required master station power per sector	104,375		Watts		For Remote link reciprocity				
37	Master Station ERP per sector	13,140,018		Watts						
38	Gain of one master station antenna	21		dBi	2.0					
39	Number of receive antennas per sector	4	1		6.0					
40	Master station noise level		Quiet Rural		0.0		19.1757			
41	Master station coverage area	3,140,000		square km						
42	Number of Master Stations	50		Count		Number of master stations evenly spaced across the US				
43	Master station overlap reduction factor	40%				Reduction for worst-case overlap - see map				
44	Master station geographical diversity gain	7.8								
45	Master station relative gain	18.2								
47	**REMOTE** *[see WH notes below]*									
48	Remote station power	500		Watts	2.2					
49	Remote station antenna gain (3-4 dbi seems possible for *mobiles*, with fractal-meta)	4		dBi	0.0					
50	Remote station noise level		Rural		-7.2					
51	Number of Remote Stations per local mesh	6		Count		Assume geographically dispersed remotes in a local mesh				
52	Assume Remote stations in mesh		Yes	Yes or No	1.0					
53			Rural							
54	Instructions [by Robert Mawrey]	*Notes, by W. Havens* (in addition to some inserted above)								

Instructions (Robert to Warren) and Notes (Warren to MNDA readers) on a page below.

More Aggressive-1 BTDY (**BEST** time day and year) configuration using the MBC network estimation tool, v1.8, by Robert Mawrey, PhD for SkyTel.
Must read WH Notes on a page below and discuss with me to understand how to assess this . *Other configuration results on subsequent pages below.*

ZOOM to 200% or more, ideally on wide screen.

	A	B	C	D	E	F	G	H	I	J
1	*[WH: MUST READ: This models only the use of one 250 kHz wide channel. See WH notes below as to use of wider, or additional, channels, and other critical notes for understanding this and other runs using this current " v. 1.8(wh)".]*									
2	**RESULTS**	**Value**	**Unit**			**Notes**				
3	Estimated Remote Link Short Message Wait Time (Average) [see WH note below]	2.77	Seconds			For a single master and single remote	0.923039	0.046152	1300.054	
4	Estimated Remote Link Short Message Wait Time 0th Percentile	#NAME?	#NAME?			[This function not yet activated: needs Mac Version of SimTools.xlam or equal.]				#NAME?
5	Estimated Remote Link Throughput	29,084	bps			For a single master and single remote	3	87252		
6	Estimated Remote Link Short Message Wait Time ***with diversity***	0.12	Seconds				3			
7	Estimated Remote Link Short Message Wait Time with diversity 0th Percentile	#NAME?	#NAME?			[This function not yet activated: needs Mac Version of SimTools.xlam or equal.]				
8	Estimated Remote Link Throughput ***with Diversity***	6,781,073	bps							
10	*[WH: "This MASTER section, & related items below, assumes existing Yagi antennas, but I plan Metamaterials-Fractal Antennas & smart phased arrays, which, per literature on these, should allow better performance, less transmit power, less components & size & cost.]*									
11	**MASTER**									
12	Required master station power per sector per channel	10,437	Watts			For Remote link reciprocity				
13	Master Station ERP	1,314,002	Watts							
14	Required master station power per sector	104,375	Watts							
15	Total output power per master station	6,575,617	Watts							
16	Number of sectors required	63								
17	Total number of antennas per master station	315								
18	**Input Parameter**	**Input Values (White)**	**Reference Values**	**Unit**	**Gain relative to ref. system (dB)**	**Notes**	Temp1	Temp2	Temp3	
19	Frequency	40	46	MHz	0.5	Factors in frequency gain (10*LOG((46/B2)^3)) and cosmic noise (-9.554*LN(B2) + 51)				
20	Bandwidth	1000	25	kHz		Meteor burst channel bandwidth				
21	Coding Gain	10.0	0	dB	10.0	Gain Relative to no coding for Cognitive Radio with Good codes				
22	Number of Channels	10				Number of channels per master sector. Power increased for each channel.				
23	Adaptive Data or Coding throughput improvement	1.5	1	Factor	1.5	Broadcast mode can only be 1 *[WH: with MB radar, needed for MB PNT, broadcast probably can get info for adaptive data]*.				
24	Wait-time Percentile					Confidence that the message will be received. [This function not yet activated: needs Mac Version of SimTools.xlam or equal.]				
25	Data Rate	2,000	2,000	bps						
26	Area of the continental USA	8,080,464		square km						
27	Remote System gain relative to the reference system				22.2					
28	Message Length	40	40	Characters		320 bits				
29	Hemisphere	Northern								
30	Time of Day [17:00 is worst, and 6:00 is best.]		6:00				3.996477			
31	Month of Year [Feb-Mar is worst, and Jl-Aug is best (good for farmers, etc.)]		Jul			See curve on Yearly tab	3.0			
33	**MASTER** *[see WH notes below]*									
34	Required master station power per sector per channel	10,437	1,000	Watts	10.2	For Remote link reciprocity	40.18596	10437.49		
35	Master Station ERP	1,314,002		Watts						
36	Required master station power per sector	104,375		Watts		For Remote link reciprocity				
37	Master Station ERP per sector	13,140,018		Watts						
38	Gain of one master station antenna	21		dBi	2.0					
39	Number of receive antennas per sector	4	1		6.0					
40	Master station noise level		Quiet Rura		0.0		19.17566			
41	Master station coverage area	3,140,000		square km						
42	Number of Master Stations	50		Count		Number of master stations evenly spaced across the US				
43	Master station overlap reduction factor	40%				Reduction for worst-case overlap - see map				
44	Master station geographical diversity gain	7.8								
45	Master station relative gain	18.2								
47	**REMOTE** *[see WH notes below]*									
48	Remote station power	500		Watts	2.2					
49	Remote station antenna gain (3-4 dbi seems possible for *mobiles*, with fractal-meta)	4		dBi	0.0					
50	Remote station noise level		Rural		-7.2					
51	Number of Remote Stations per local mesh	6		Count		Assume geographically dispersed remotes in a local mesh				
52	Assume Remote stations in mesh		Yes	Yes or No	1.0					
53			Rural							
54	**Instructions** [by Robert Mawrey]	***Notes**, by W. Havens* (in addition to some inserted above)								

Instructions (Robert to Warren) and Notes (Warren to MNDA readers) on a page below.

Medium Aggressive-1 WTDY (**WORST** time day and year) configuration using the MBC network estimation tool, v1.8.....

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ZOOM to 200% or more, ideally on wide screen.

	A	B	C	D	E	F	G	H	I	J
1	*[WH: MUST READ: This models only the use of one 250 kHz wide channel. See WH notes below as to use of wider, or additional, channels, and other critical notes for understanding this and other runs using this current " v. 1.8(wh)".]*									
2	**RESULTS**	**Value**	**Unit**			**Notes**				
3	Estimated Remote Link Short Message Wait Time (Average) [see WH note below]	1.50	Minutes			For a single master and single remote	0.9995	1.49924	40.0202	
4	Estimated Remote Link Short Message Wait Time 0th Percentile	#NAME?	#NAME?			[This function not yet activated: needs Mac Version of SimTools.xlam or equal.]				#NAME?
5	Estimated Remote Link Throughput	180	bps			For a single master and single remote	1.5	270		
6	Estimated Remote Link Short Message Wait Time ***with diversity***	0.26	Minutes				1.5			
7	Estimated Remote Link Short Message Wait Time with diversity 0th Percentile	#NAME?	#NAME?			[This function not yet activated: needs Mac Version of SimTools.xlam or equal.]				
8	Estimated Remote Link Throughput ***with Diversity***	2,097	bps							
10	*[WH: "This MASTER section, & related items below, assumes existing Yagi antennas, but I plan Metamaterials-Fractal Antennas & smart phased arrays, which, per literature on these, should allow better performance, less transmit power, less components & size & cost.]*									
11	**MASTER**									
12	Required master station power per sector per channel	10,162	Watts			For Remote link reciprocity				
13	Master Station ERP	807,200	Watts							
14	Required master station power per sector	20,324	Watts							
15	Total output power per master station	812,964	Watts							
16	Number of sectors required	40								
17	Total number of antennas per master station	120								
18	**Input Parameter**	**Input Values (White)**	**Reference Values**	**Unit**	**Gain relative to ref. system (dB)**	**Notes**	Temp1	Temp2	Temp3	
19	Frequency	43	46	MHz	0.2	Factors in frequency gain (10*LOG((46/B2)^3)) and cosmic noise (-9.554*LN(B2) + 51)				
20	Bandwidth	250	25	kHz		Meteor burst channel bandwidth				
21	Coding Gain	7.0	0	dB	7.0	Gain Relative to no coding for Cognitive Radio with Good codes				
22	Number of Channels	2				Number of channels per master sector. Power increased for each channel.				
23	Adaptive Data or Coding throughput improvement	1	1	Factor	0.0	Broadcast mode can only be 1 *[WH: with MB radar, needed for MB PNT, broadcast probably can get info for adaptive data].*				
24	Wait-time Percentile					Confidence that the message will be received. [This function not yet activated: needs Mac Version of SimTools.xlam or equal.]				
25	Data Rate	2000	2,000	bps						
26	Area of the continental USA	8,080,464		square km						
27	Remote System gain relative to the reference system				14.5					
28	Message Length	40	40	Characters		320 bits				
29	Hemisphere	Northern								
30	Time of Day [17:00 is worst, and 6:00 is best.]		17:00				1.00342			
31	Month of Year [Feb-Mar is worst, and Jl-Aug is best (good for farmers, etc.)]		Feb			See curve on Yearly tab	1.0			
33	**MASTER** *[see WH notes below]*									
34	Required master station power per sector per channel	10,162	1,000	Watts	10.1	For Remote link reciprocity	40.0698	10162		
35	Master Station ERP	807,200		Watts						
36	Required master station power per sector	20,324		Watts		For Remote link reciprocity				
37	Master Station ERP per sector	1,614,400		Watts						
38	Gain of one master station antenna	19		dBi	0.0					
39	Number of receive antennas per sector	2	1		3.0					
40	Master station noise level		Quiet Rural		0.0		19.0595			
41	Master station coverage area	3,140,000		square km						
42	Number of Master Stations	25		Count		Number of master stations evenly spaced across the US				
43	Master station overlap reduction factor	40%				Reduction for worst-case overlap - see map				
44	Master station geographical diversity gain	3.9								
45	Master station relative gain	13.1								
47	**REMOTE** *[see WH notes below]*									
48	Remote station power	1000		Watts	5.2					
49	Remote station antenna gain (3-4 dbi seems possible for *mobiles*, with fractal-meta)	3		dBi	-1.0					
50	Remote station noise level		Rural		-7.1					
51	Number of Remote Stations per local mesh	3		Count		Assume geographically dispersed remotes in a local mesh				
52	Assume Remote stations in mesh		Yes	Yes or No	1.0					
53			Rural							
54	**Instructions** [by Robert Mawrey]	*Notes, by W. Havens* (in addition to some inserted above)								

Instructions (Robert to Warren) and Notes (Warren to MNDA readers) on a page below.

Medium Aggressive-1 BTDY (**BEST** time day and year) configuration using the MBC network estimation tool, v1.8.....
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1	*[WH: MUST READ: This models only the use of one 250 kHz wide channel. See WH notes below as to use of wider, or additional, channels, and other critical notes for understanding this and other runs using this current " v. 1.8(wh)".]*									
2	**RESULTS**	Value	Unit			Notes				
3	Estimated Remote Link Short Message Wait Time (Average) [see WH note below]	7.53	Seconds			For a single master and single remote	5.01901	0.12548	478.182	
4	Estimated Remote Link Short Message Wait Time 0th Percentile	#NAME?	#NAME?			[This function not yet activated: needs Mac Version of SimTools.xlam or equal.]				#NAME?
5	Estimated Remote Link Throughput	2149	bps			For a single master and single remote	1.5	3224		
6	Estimated Remote Link Short Message Wait Time ***with diversity***	1.29	Seconds				1.5			
7	Estimated Remote Link Short Message Wait Time with diversity 0th Percentile	#NAME?	#NAME?			[This function not yet activated: needs Mac Version of SimTools.xlam or equal.]				
8	Estimated Remote Link Throughput ***with Diversity***	25,058	bps							
10	*[WH: "This MASTER section, & related items below, assumes existing Yagi antennas, but I plan Metamaterials-Fractal Antennas & smart phased arrays, which, per literature on these, should allow better performance, less transmit power, less components & size & cost.]*									
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12	Required master station power per sector per channel	10,162	Watts			For Remote link reciprocity				
13	Master Station ERP	807,200	Watts							
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15	Total output power per master station	812,964	Watts							
16	Number of sectors required	40								
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18	**Input Parameter**	**Input Values (White)**	**Reference Values**	**Unit**	**Gain relative to ref. system (dB)**	**Notes**	Temp1	Temp2	Temp3	
19	Frequency	43	46	MHz	0.2	Factors in frequency gain (10*LOG((46/B2)^3)) and cosmic noise (-9.554*LN(B2) + 51)				
20	Bandwidth	250	25	kHz		Meteor burst channel bandwidth				
21	Coding Gain	7.0	0	dB	7.0	Gain Relative to no coding for Cognitive Radio with Good codes				
22	Number of Channels	2				Number of channels per master sector. Power increased for each channel.				
23	Adaptive Data or Coding throughput improvement	1	1	Factor	0.0	Broadcast mode can only be 1 *[WH: with MB radar, needed for MB PNT, broadcast probably can get info for adaptive data].*				
24	Wait-time Percentile					Confidence that the message will be received. [This function not yet activated: needs Mac Version of SimTools.xlam or equal.]				
25	Data Rate	2000	2,000	bps						
26	Area of the continental USA	8,080,464		square km						
27	Remote System gain relative to the reference system				14.5					
28	Message Length	40	40	Characters		320 bits				
29	Hemisphere	Northern								
30	Time of Day [17:00 is worst, and 6:00 is best.]		6:00				3.99648			
31	Month of Year [Feb-Mar is worst, and Jl-Aug is best (good for farmers, etc.)]		Jul			See curve on Yearly tab	3.0			
33	**MASTER** *[see WH notes below]*									
34	Required master station power per sector per channel	10,162	1,000	Watts	10.1	For Remote link reciprocity	40.0698	10162		
35	Master Station ERP	807,200		Watts						
36	Required master station power per sector	20,324		Watts		For Remote link reciprocity				
37	Master Station ERP per sector	1,614,400		Watts						
38	Gain of one master station antenna	19		dBi	0.0					
39	Number of receive antennas per sector	2	1		3.0					
40	Master station noise level		Quiet Rural		0.0		19.0595			
41	Master station coverage area	3,140,000		square km						
42	Number of Master Stations	25		Count		Number of master stations evenly spaced across the US				
43	Master station overlap reduction factor	40%				Reduction for worst-case overlap - see map				
44	Master station geographical diversity gain	3.9								
45	Master station relative gain	13.1								
47	**REMOTE** *[see WH notes below]*									
48	Remote station power	1000		Watts	5.2					
49	Remote station antenna gain (3-4 dbi seems possible for *mobiles*, with fractal-meta)	3		dBi	-1.0					
50	Remote station noise level		Rural		-7.1					
51	Number of Remote Stations per local mesh	3		Count		Assume geographically dispersed remotes in a local mesh				
52	Assume Remote stations in mesh		Yes	Yes or No	1.0					
53			Rural							
54	**Instructions** [by Robert Mawrey]	*Notes, by W. Havens* (in addition to some inserted above)								

Instructions (Robert to Warren) and Notes (Warren to MNDA readers) on a page below.

To spreadheet used in producing above:
Instructions (Robert to Warren) and
Notes (Warren to MNDA readers).
See also items on followig pages.

Instructions [by Robert Mawrey]

Enter input values into the white cells

Results are in the yellow highlighted cells

The model works by:

- Looking up (via curve fit equations) throughput and wait-time based on input parameters)
- Factoring local noise as a gain reduction effect
- Scaling the results based on spatial diversity (multiplying by spatial gain)
- Factoring in the combination of remote and relay performance
- Working out the number of sectors and antennas needed for 360 degree relay and base station coverage
- Providing a simple pricing model that is driven by number of receivers and antennas, the cost of the transmitters and underlying base costs

The sheet is not protected so do not change the blue cells

The model is only approximate and generally useful for planning purposes

The other tabs are for reference. Curve fitting was used to generate expressions from the original Wait Time, Throughput, and man-made noise curves.

The map illustrates how it is tough to evenly illuminate a fixed geographical area. This factor is included under "Master Station Overlap Reduction Factor"

The Data tab is used for form lookups and the Working Tab is simply a scratch pad.

Worst time of day and year.

Notes, by W. Havens (in addition to some inserted above)

1. MBC is complex. In addition, the diversity and other elements here have not previously been modelled, or built and operated. A reader needs a bacground in these to understand this spreadsheet. *A reader should consider runs on this sheet I provide, after explanation by me (and as may be arranged, Robert Mawrey, PhD).*

2. This current version models use of one channel, which I set to 1000 kHz. (Coding gain increases a lot up to below that point, then the curve lessens. SkyTel has less than this now, but enought for about 80% of this coding gain, and with pending application, just about fully this gain. Also, this amount is far less than the MHz-worth of 30-50 MHz SkyTel seeks in several spectrum swaps). Throughput will double for each additional same-width channel used, but wait time will not improve as much (how much, if any, depends on message size, and what is meant by wait time: some messages will be useable if split over two or more MBC trail-links, etc. *Herein*, we use "wait time" to mean a MBC link sufficient to accommoate in full the noted assumed message size (lenght) of 40 characters. *The more that messages can be viably used is sent over multiple links (as long as completed in 'x' period of time), the more that througput and not "wait time" is important*. For any targetted use, these matters must be determined, and this model added to, and adjusted.

3. As shown above, for wait time, this is "average" for the selected month and time of day, meaning 1/2 events worse and 1/2 better in that window of time. The input for Perecentile is awaiting the above-noted installation of SimTools.xlam or equivalent. This can be otherwise estimated by referece to published curves.

4. The Remote station power setting varies the master station power. I have this set for high master station power since I am looking (first) at broadcast mode, since the delivery of data is more critical to have less wait time and more throughput vs. remote-to-master talk-back links (for N-RTK, etc.) Thus, remotes can have considerably less ERP than shown here for a recripocal, balanced, two-way link if they do not have to talk back as much as they receive. Also, MBC ground stations get refection off the ground of approx 3 db: this is assumed in the setting, the rest is in antenna gain.

5. As indicated above, for phase-2 MBC (which this tool is meant for, not for simple traditional MBC), I believe I can use metamaterials-fractal anteannas as master and remote stations, and smart phased arrays using such also at master stations, and to some degree in fixed remotes, and in mobile remotes in mesh networks. Per published tech papers and some projection (since this is a quickly develping tech), (1) I am aggressive here as to antenna gains, and (2) I also expect to need less antennas than indicated here. One would have to read these tech papers to grasp this rationale and assess the validity of it.

6. Re "Quiet Rural" setting. For master stations, they will be in in radio-quiet rural areas. Remotes stations will be in rural to urban areas, but will use metamaterial-fractal antennas, Cognitive Radio, frequency width and diversity, and other means, to limit man-made noise (generally from point sources): we thus use "rurual" setting.

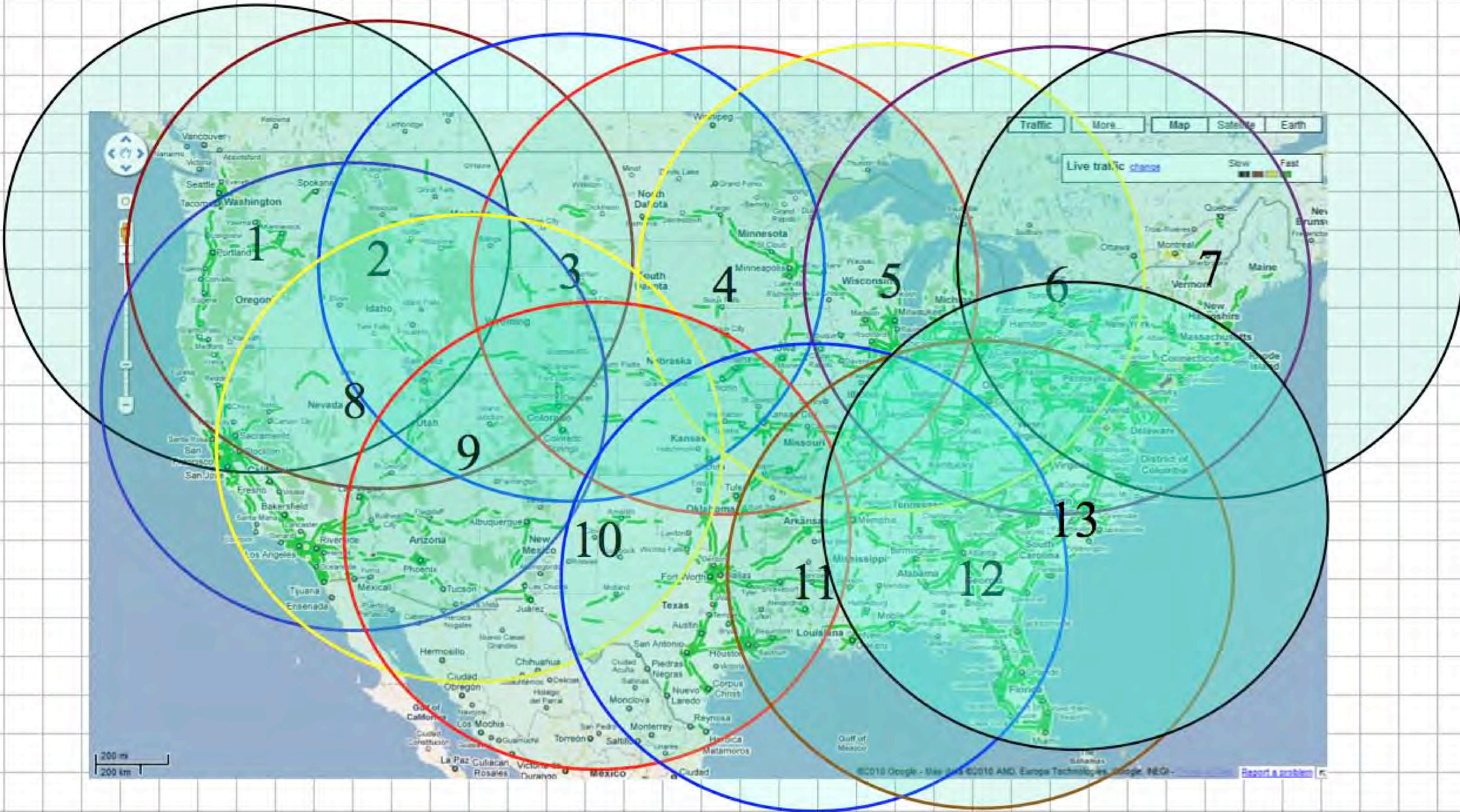
W. Havens & Companies

FCC meeting on June 17, 2014

The following are additional slides on one topi
c I will briefly present.

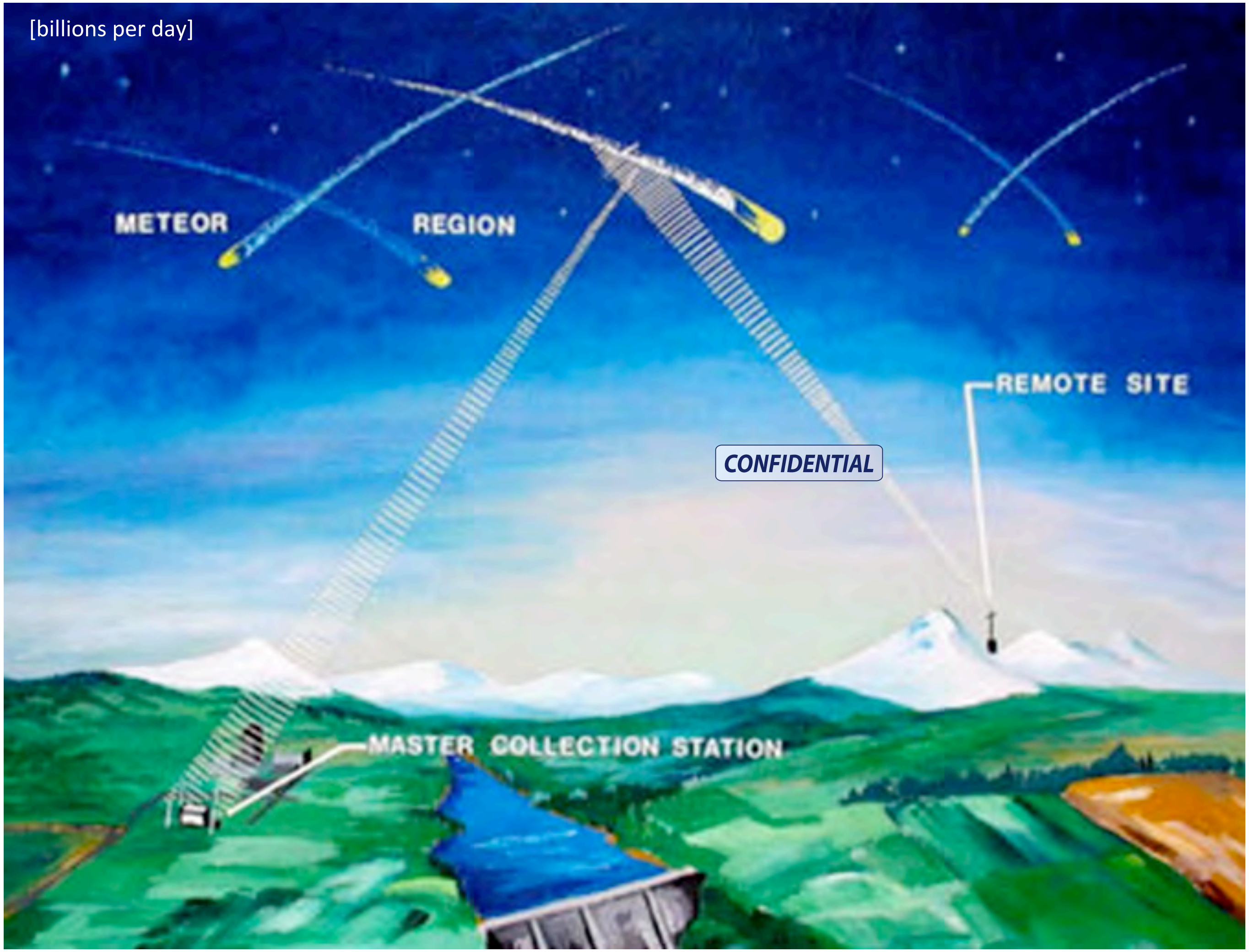
- W Havens

MBs- example: 13 MBs, lower mid-path optimized (ok for mobile). 2 to 6 cell overlap as depicted (more with more cells of course).
- Spaced here to also cover most all of Canadian polulation & industry (assumes approval from Industry Canada for two way, for broadcast may not need approval?).
  - (Maybe floating offshore MBs also: increase overlap onshore, extend to shipping, use sun & kinetic-waves for energy).
  - (Maybe MRs on commercial planes on major scheduled routes: they get free telemetry in exchange to perform Relay function. With CCR, this should work.)
- Coverage can be made oblong/ ameoba shaped by adjusting antennas to change coverage and overlap. Ideally on the fly or at least maually by season and changing demand. Partner with US DOA & other Fed agencies for MBs facilities, and provide telemetry in return for day to day and emergencies, PNT backup of GPS, etc.



MBC – basic link.

Can be two-way. The reflections results in a fairly small coverage spots on earth per each MBC link event.



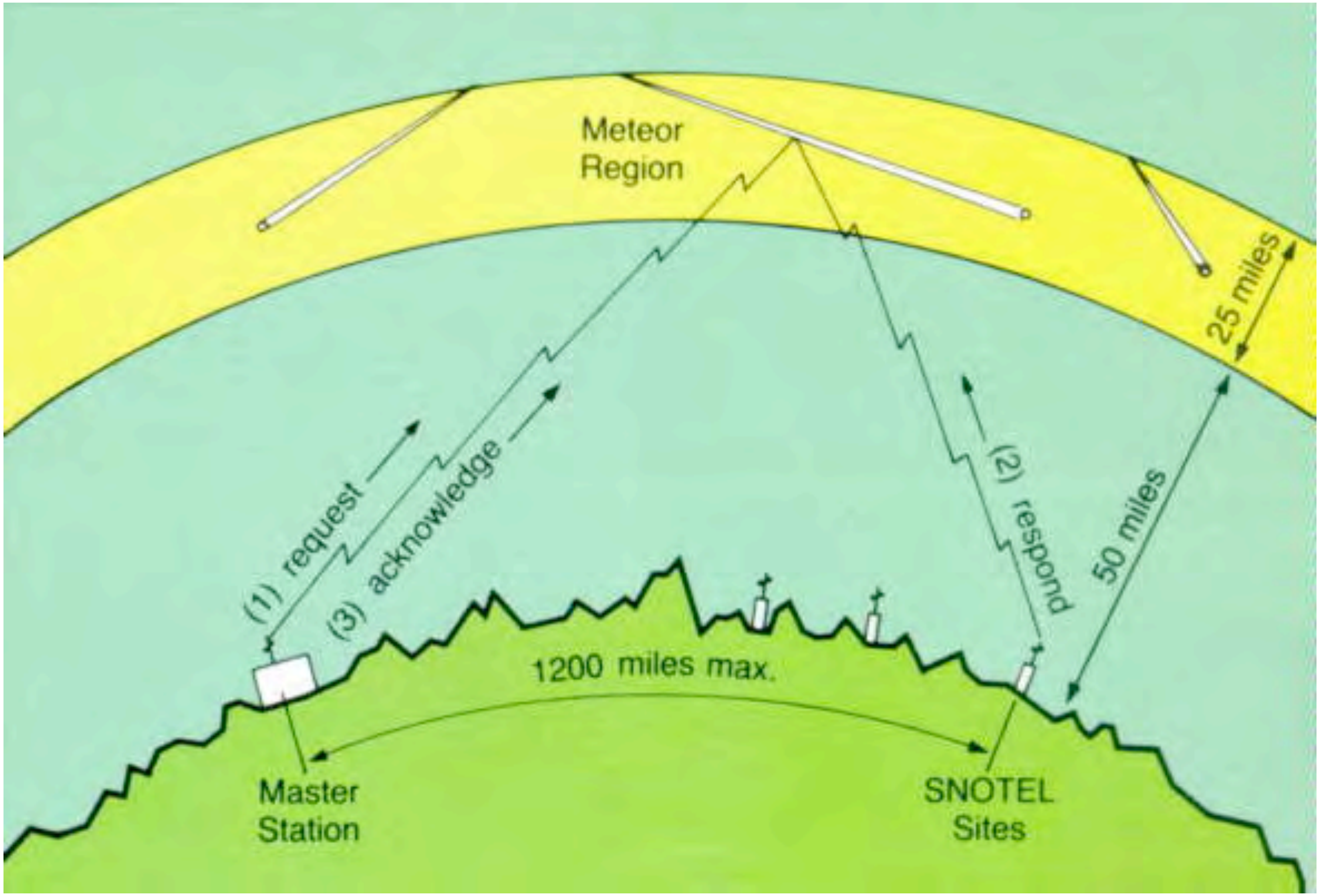
Entire continents can be covered, far offshore, and most oceans via on-ship repeaters.

The data rate and wait time depends on many things.

With modest numbers of master stations, sufficient bandwidth, power, modern digital radio tech, etc., we can get fairly high average data rates and sub-sec wait times - in worst time of year and day (under projections of our experts).

MBC – basic link. Snotel depiction.

Snotel is by US Department of Agriculture. Covers most of US.



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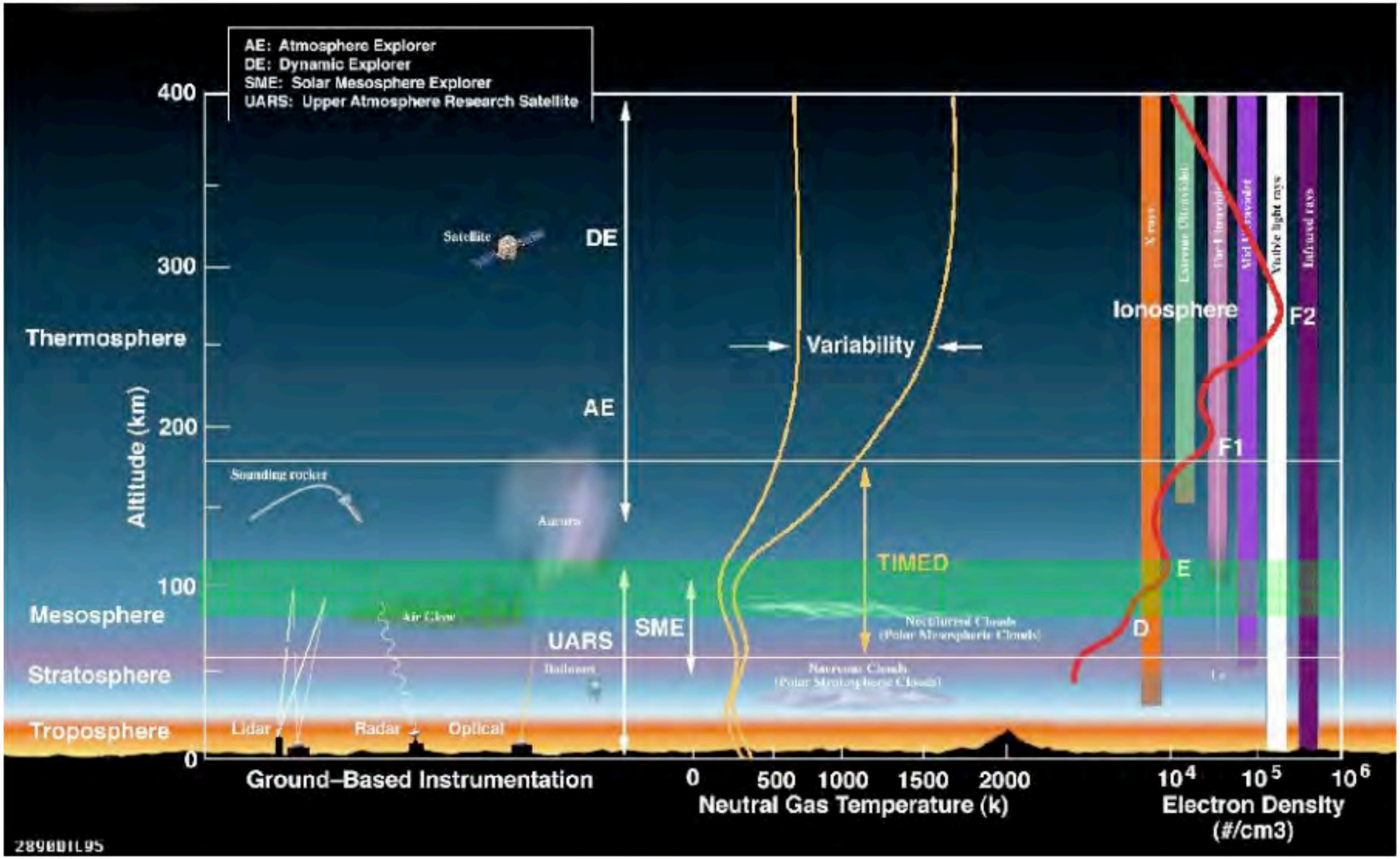

Figure 1.2: Vertical structure of Earth's Atmosphere. Important features are the temperature and electron density variation with altitude, and the existence of ionospheric layers. The transparent green band represents the meteor region (courtesy of NASA TIMED Mission).

http://www.tiger.latrobe.edu.au/abstracts/Honour_Thesis/Meteor%20Echo%20Thesis.pdf

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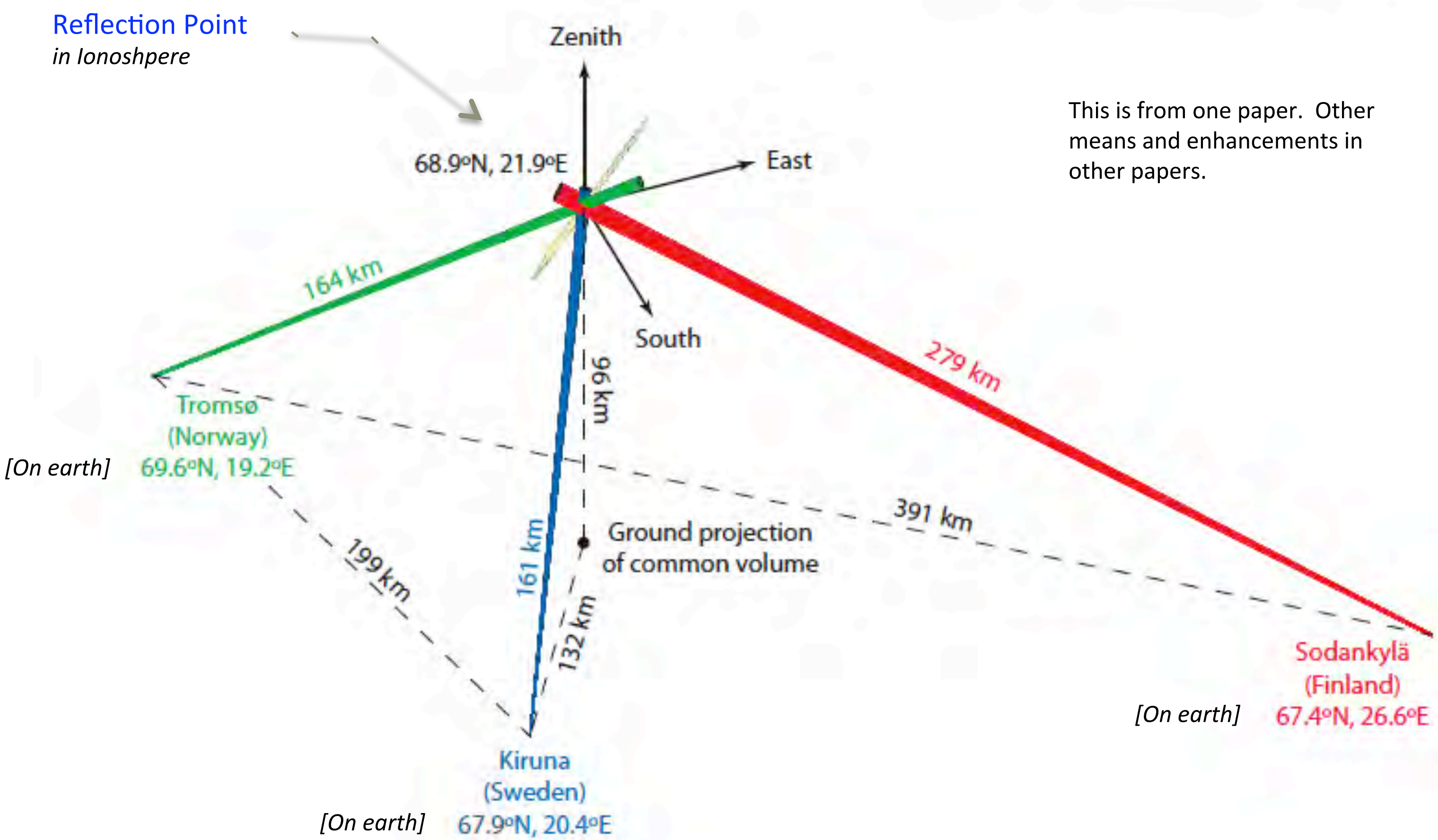
MBC reflection points location

Multi-static radar (MBC Comms systems can have far more than tri-static)



This is from one paper. Other means and enhancements in other papers.

Johan Kero

IRF Scientific Report 293. 2008

High-resolution meteor exploration with tristatic radar methods

INSTITUTET FÖR RYMDFYSIK
Swedish Institute of Space Physics
Kiruna, Sweden

MBC PNT (see also US Patent description of MBC location methods, below)

(1) With the precise timing (see below), the total distance of each leg (the earth-to-MBC reflection point leg, and that point back to earth leg) can be determined.

(2) Knowing that reflection point (see below) including where it is above earth (on a line from center of earth to the reflection point) the distance of the known point on earth (a fixed-location MBC master station) to the remote point on earth, on the other radio leg, can be determined, I think (right triangle method, seems to me as a layman).

Doing this from three or more master stations can get the location of the remote thing.

(3) Adding AoA may be some help, also.

(4) With a few vehicles and other things doing this in an area in a wireless mesh net (MBC is enhanced, anyway, with remotes in a mesh net), the location of each may be further improved with appropriate algorithms.

(5) INS and Kalman filter would be added.

Item 3 – not hard in MBC – not covered below.

Item 4 – will be done for ITS and we can use, not covered below.

Items 5 – exist, can be included – not covered below.

Further

- As indicated above, the idea is for a system independent of GNSS when it has to be, but that works with GNSS otherwise.
- The same MBC system could deliver N-RTK corrections in that regard, and other valuable radio communications, one- and two-way.
- There are some issues I can think of (which I would explain, with the MBC experts), but they do not see unresolvable considering use of "4G" MBC that will have short wait times and ample data throughput, and better antennas available these days for vehicles and substantial-size hand portables.

Even if the location accuracy is not that good except in GNSS augmentation mode, the precise time transfer may be very useful to have.
- E.g, One of the Russian uses of it, at least as presented in papers (that appears to report test results, but not real-life deployments, yet) is for very high security functions: each MBC event is used to create a unique encryption code (that cannot be predicted in advance) which is added to the MBC communications link, along with the precise timing, to create a level of communication security the authors say is above other encryption methods.

From my rough estimations thus far (based on some input by experts') I think the amount of total data capacity in a "4G" MBC nationwide (actually continent+ wide) system for the above PNT functions would be minor and well worth it.

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United States Patent [19] [11] **Patent Number:** 4,845,504
Roberts et al. [45] **Date of Patent:** Jul. 4, 1989

The foregoing system of communicating via meteor trails between a master station and a plurality of remote mobile stations may also be used to determine the position of a mobile unit communicating with the master station. One technique which may be employed with the foregoing system is for each master station to initiate a message to a mobile station along with a tone burst. The mobile unit being interrogated repeats the tone burst. Allowing for equipment delay, a phase match between a locally generated tone of the same frequency and the receive tone at the master station determines the propagation time. The length of the propagation path between mobile and master station may be computed based on the propagation time. A plurality of measurements may be taken and the shortest distance represented by each of these measurements may be used as being most reliable.

The shortest propagation path length serves to identify a corresponding distance along the earth's surface between the master station and mobile unit by assuming a height for the meteor burst. This measurement of distance along the earth's surface is made for three different master stations for the same mobile unit. Three circles can then be drawn centered at a respective master station having a radius equal to the measured distance to the mobile unit. The common intersection of the circles identifies the mobile unit location.

This old patent did not consider the above: (1) MBC Precise Timing (Russian work), (2) MBC multistatic radar for Reflection-Point Determination, or (3) '4G' MBC which will allow near-constant data links (and fairly high data rates), etc. But this patent had many of the main MBC PNT ideas. The techniques now appear available for the following.

An alternate procedure which involves the use of three (3) master stations may also be implemented for determining the unique position of a mobile unit with respect to the three master stations. The azimuth and elevation of each incoming signal to each master station from the mobile unit in question is measured. Also, propagation time of signals originating from the mobile unit to each of the master stations is determined as in the previous methods. Assuming a height above the earth's surface for the meteor trail point of reflection, a unique vector is determined for each of the master stations pointing to the unique point of reflection for a given master station, as well as the distance from the point of reflection to the mobile unit. Therefore, three circles may be determined with the center given by the projection of the three reflection points to the earth's surface. The intersection of the three circles, one for each master station receiving the mobile unit communication, gives the position location for the mobile unit.

Continued.

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A still further procedure for position locating a mobile station requires the use of three positionally distinct meteor bursts. The mobile radio station will initiate three consecutive transmissions following three consecutive master carrier senses. The transmissions are separated in time sufficient to insure that a different meteor trail is used for each transmission. By noting the azimuth and elevation of the incoming transmissions to the master station using standard direction finding equipment, the direction of the meteor trail, via which the transmission is received, is known. Using the knowledge of the meteor trail height above the earth's surface, and the incoming signal angle of elevation and azimuth permits the distance of the meteor burst from the master station to be determined. A circle may be drawn centered at each of the three meteor trails. The radius of the circle represents the distance from the meteor trail to the mobile radio station. This distance may be computed by subtracting from the distance represented by the one way propagation time between the mobile radio station and master station via the meteor trail, the distance between the master station and meteor trail. The three circles thus constructed for three meteor trails will have a unique intersection representing the location of the vehicle with respect to the master station.

This invention was made with United States Government support under Contract No. N00014-02-C-0457 awarded by the Department of the Navy. The United States Government has certain rights in this invention.

The present invention describes an apparatus and method for computing three dimensional coordinates of a target by using three, one dimensional bistatic range measurements to the same target.

The first bistatic range measurement is combined with the second bistatic range measurement and the third bistatic range measurement to obtain a correct three dimensional target position with respect to the radar transmitter as well as an incorrect three dimensional target position with respect to the radar transmitter. The solution for the three dimensional target position is arrived at by combining the first bistatic range measurement with the second bistatic range measurement and the third bistatic range measurement in a quadratic equation yielding two solutions (roots) descriptive of the correct three dimensional target position and the incorrect three dimensional target position. In choosing between the two solutions (roots) of the quadratic equation, the incorrect three dimensional target position is identified and eliminated by comparing the (incorrect) three dimensional target position to the transmitter location, the first receiver location, the second receiver location, and the third receiver location. Another way to distinguish between the two roots is by comparing the solved for target altitude with the transmitter altitude. The incorrect three dimensional target position is identified by the target altitude exceeding a threshold, typically set above 80,000 feet AGL.

In MBC, using many master base stations for co-located MBC multistatic radar, and 4G MBC radio techniques, we would have near constant links (radar and comm) to each area (over the continent or other large coverage region): and these links would be from many master base / radar stations.

Thus, a technique like this may work.

In addition, use of radio mesh-nets among the remote things will allow further improvements, as is the case with GNSS. See Kannan, Venky papers and others.

Generally, all of the MBC and other sky-even radar I have read, does not consider a nationwide infrastructure of MBC comms and radar, and terrestrial augmentation of many kinds, as we have in mind. Thus, we can make major improvements, I believe.

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MBC – precise timing

STUDY OF THE TIME OF UNAMBIGUOUS TRANSITION TO THE CARRIER PHASE DURING AUTOMATIC TIMESCALE CONTROL USING MEASUREMENTS IN A METEOR-BURST RADIO CHANNEL

Radiophysics and Quantum Electronics
Vol. 47, No. 12, 2003

V. A. Korneev,
V. V. Sidorov
and L. A. Épiktetov

In this paper, we consider the possibilities of resolving ambiguity of the phase measurements at the carrier frequency in a multifrequency meteor-burst synchronization system. To estimate the ambiguity-resolution errors, an optimal linear filtering is used. Statistical parameters are obtained with the use of a computer model. The results can be used for choosing such parameters of the meteor-burst synchronization system as frequency band and transmitter power for the specified synchronization accuracy.

1. INTRODUCTION

At present, along with the widely used satellite systems, systems of time-signal transmission via meteor-burst radio channels provide for the maximum accuracy of time-scale synchronization. The existing equipment for meteor-burst synchronization developed at the Kazan' State University allows us to transmit time marks via meteor-burst radio channels with error not exceeding 2 to 5 ns and track the measurements of the relative shift of time scales with error smaller than 0.5 ns using the phase of a carrier frequency in the interval from 40 to 60 MHz [1]. In this case, slight improvement of the equipment is sufficient for resolving the measurement ambiguity at the carrier frequency and implementing measurements of absolute values of the scale shift. Experiments conducted at Kazan' University in the period from 1988 to 1995 show that synchronization errors due to reciprocity-principle violation in a meteor-burst radio channel do not exceed, on the average, a few tens of nanoseconds and mainly comprise noise error and hardware calibration error [2–4]. Such an accuracy exceeds the capabilities of the standard satellite navigation systems GPS/GLONASS and allows us to rank meteor-burst synchronization among modern active methods of time-signal transmission via satellite communications channels. Therefore, for the GPS/GLONASS navigation systems, the time-signal transmission accuracy at distances comparable with meteor-channel paths does not exceed 20 to 40 ns [5–7]. Active satellite systems ensure noise and systematic errors no larger than 1 and 4 ns, respectively [8, 9]. The advantages of meteor-burst radio communication ensuring its wide use are relative simplicity, reliability, and efficiency, which is sometimes more important than high throughput [10]. We should also emphasize that meteor-burst communication is autonomous since its successful operation only requires two equipment sets without using other services. The disadvantage of the meteor-burst synchronization compared with satellite systems is its limited operation range (1700 to 1800 km) due to the nature of a meteor-burst radio channel.

Difficulties related to the features of meteor-burst radio channels, such as nonuniformity and variable measurement accuracy require a relevant processing algorithm, in particular, when resolving ambiguity of the phase measurements at the carrier frequency.

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Information Protection Based on Nanosecond Synchronization of Time Scales in Meteor Burst Channel

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Kazan State University, Kazan, Russia
Received October 7, 2007

Abstract—The work is dedicated to metrological validation of meteor-based method of information protection—new technique for distant encryption key generation which might be capable of providing thorough security. The method is based on high-precision phase measurements of radio signal propagation time performed simultaneously in both forward and backward directions. These measurements are possible only if the communicants' time scales are synchronized with nanosecond precision, which is shown to be possible by meteor time transfer. In order to account for short-term instability of quantum frequency standards, considering irregularity and variable precision of meteor measurements, we use optimal linear filtration and experimental measurement analogue, based on the results of meteor synchronization experiment conducted on the Mendeleevo(Moscow)–Kazan radio path. The possibility of using a meteor channel in two modes for remote time scale synchronization and encryption key generation is shown together with estimates for the capacity of this procedure.

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Appendix

Following slides

More on:

MBC reflection point location determination, components

SkyTel plans for MBC systems including for PNT

Etc.

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The sub-second wait times (delays) noted below must be, I believe, for times and days that are not worst time and worst day (based on all other reports I have read and my discussions with our MBC experts, and the MBC performance estimation tool they develoed for SkyTel).

But the below still is a useful "reality check," since if they mean best time or average time of day and year, then with improvements we plan (that I am sure no one else has implemented in "current stat of the art systems"), our sub-second wait times for worst time of day and year *roughly correspond to the statement below.*

I understand that David Fraser is a well-known MBC expert.

Using Artificial Neural Networks for Meteor-Burst Communications Trail Prediction

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Abstract

The use of meteor ionisation trails as 'cheap satellites' to reflect radio waves between two points on the earth's surface is an established technique, called Meteor Burst Communications (MBC). For MBC systems to take advantage of the different amplitude and duration patterns of different trail types it is necessary to predict these patterns from features of initial signals reflected from the trails. The work described in this paper attempts to predict trail amplitude, duration, and trail type using neural networks. Results include a picture of what features of the beginning of the trail are most and least important for recognising various characteristics of the rest of the trail, some significant results as regards trail type prediction, and high correlations between actual and predicted peak amplitudes of trails. The latter is an important result.

Keywords: Neural networks, Applications to telecommunications.

1. Introduction

Billions of meteors[1] enter the earth's atmosphere every day.There is an inverse relationship between meteor size and meteor frequency [LM+90]. Although the vast majority of the meteors are small (around the size of a grain of sand), their solar orbital velocity is high enough that on entering the upper atmosphere (between 80 and 120km from the earth's surface) and burning up, they leave ionisation trails tens of kilometres long.

While Nagaoka [Nag29] was the first to postulate a connection between meteors and radio reflections, his initial hypothesis that the meteors would be impediments to radio communication was soon discovered to be incorrect. Picard [Pic31] and Skellet [Ske32] independently determined that meteors, or more specifically the trails of ionisation that they leave in their wake, could enhance radio reflection. The use of meteor ionisation trails as 'cheap satellites' to reflect radio waves between two points on the earth's surface (limited by the earth's curvature to about 2000km apart) has since become an established technique. This form of communication is called Meteor-Burst Communications (MBC).

The advantages of MBC include:

- Low price. Ionised trails are free and the communication hardware is relatively cheap [Whi88, CR87].
- Robustness. The ground stations are simple and reliable [BB77, Cro77, Day82]. Meteor trails 'cannot be shot down', which makes MBC attractive for military applications [Hel87, Oet80, Boy88]. The transmission is largely impervious to electrical interference, such as polar and auroral disturbances [Hel87, DG+57].
- Suitability for remote use. MBC systems have a range of up to 2000km, and due to their robustness and low power consumption the ground stations have low maintenance requirements [Mor88].
- Resistance to ground interception and jamming. The small footprint of the reflection means that to intercept or jam the signal requires being close to the receiving ground station [Hel87].

A number of large-scale MBC systems are in place. Important systems include:

- The United States Department of Agriculture's SnoTel telemetry system [BB77, Cro77, Day82], which comprises some 500 stations in the American West.
- The Alaska Air Command system of the US Air Force [KR86, Hof88, Sch90].
- The Chinese MBC network used by the Chinese military for communications from base stations in Beijing, Lanzhou and Urumqi to remote army camps, operating as the standard link for low priority traffic and the backup link for high priority traffic [Sch90].

A detailed review of MBC systems appears in [MF93].

The major difficulty with MBC is that an ionisation trail must be correctly orientated in the correct area of the sky between stations for communication to take place. The average time between usable trails varies according to known daily and seasonal cycles in meteor arrival rates, as well as being dependent on the transmitter power and the antennas used. Current state-of-the-art systems have delays of less than a second between usable trails. The channel is still sporadic however, and this means that MBC is most suited to data transmission, as opposed to real-time voice or video.

This paper first describes the different types of meteor trails, and the effect of the differnet types on the communications capacity of the MBC channel. The advantages of being able to accurately predict future trail amplitude and duration characteristics on the basis of signal reception in the early part of a trail are explained. After this various neural net approaches to the prediction of trail type, duration, and peak amplitude are discussed, and important results highlighted.

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SkyTel. Advanced Meteor Burst Communications, as planned, will have fixed and mobile MBC stations in nationwide mesh nets. These, with the master stations, may be used with this or similar multi-static radar to determine the position of MB plasma trails used for MBC, and then provide positioning of mobile MBC receivers. This can be enhanced, it seems, with sub-nanosecond MB time schronization as Russian MBC experts have described and tested (see our Scribd papers on that).

Forward Scatter Radar for Future Systems

Jerome Glaser
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Los Angeles, CA

ABSTRACT

This paper reviews the concept of a forward-scatter radar (FSR) which exploits the enhanced bistatic radar cross-section of a target in the forward direction (as opposed to the conventional back-scatter direction). FSR has the potential to reliably detect and track small air-vehicles with high sensitivity. Fundamentals of radar (including monostatic, bistatic, and multistatic) and a brief history are presented. Limitations of FSR radars are presented along with methods for overcoming them based on new technologies – accurate electromagnetic simulators, mesh networks, global positioning system (GPS) location of illuminators and receivers, and smaller and lighter transmitters and receivers. A program plan to accomplish these goals is given in the Appendices, along with an example of solving the target location for three transmitters and one receiver.

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INTRODUCTION

In conventional radar configurations, the transmitter and receiver are collocated, and thus can be considered monostatic radar. Conversely, bistatic radar is composed of a transmitter and a receiver that are physically separated. Multistatic radar has transmitting and receiving apertures located in various positions. A recent paper makes it clear why a new look at multi-static systems is necessary at this time.

> "Compared to conventional radars, multistatic radars have the potential to provide **significantly improved interference-rejection**, tracking and discrimination performance in **severe EMI and clutter environments**. They can potentially provide significantly improved target tracking accuracy because of the large baseline between the various apertures. The resulting angular resolution can be orders of magnitude better than the resolution of a monolithic system (single large radar). The same angular resolution can provide improved interference rejection."[1]

In addition, orthogonal frequency division multiplexing (OFDM) can improve the performance of a radar network, in which each radar system would be either monostatic or bistatic. This configuration enables the classification of objects by ensuring each object is observed from different angles.[2]

What is Forward Scatter Radar?

The concept of forward scatter radar can be briefly described as a bistatic or multistatic configuration where the bistatic angle is close to 180 degrees. The bistatic angle is the angle at which the transmitted electromagnetic energy is scattered off of the target and received, as shown in Figure 1.

As shown, a typical transmitting site contains an oscillator, direct digital synthesizer (DDS), amplifier, driver, and antenna. A typical receiver site contains an oscillator, mixer, DDS, and acquisition system, and antenna. The three-dimensional location of each FSR is obtained through individual links with the GPS satellites. These links require a separate GPS antenna and receiver.

PHENOMENOLOGY

The forward scattered lobe was first predicted by Gustav Mie in the early 1900s.[3] It is produced when an electromagnetic wave illuminates an object and casts a shadow. The shadow occurs because electrical currents are induced in the object whose secondary radiation cancels the incident wave. By Babinet's Principle, these currents are equivalent to the radiation from currents that flow on a planar aperture whose shape is the same as that of the shadow, as shown in Figure 2.[4]

Another explanation is that the interference between the inci-

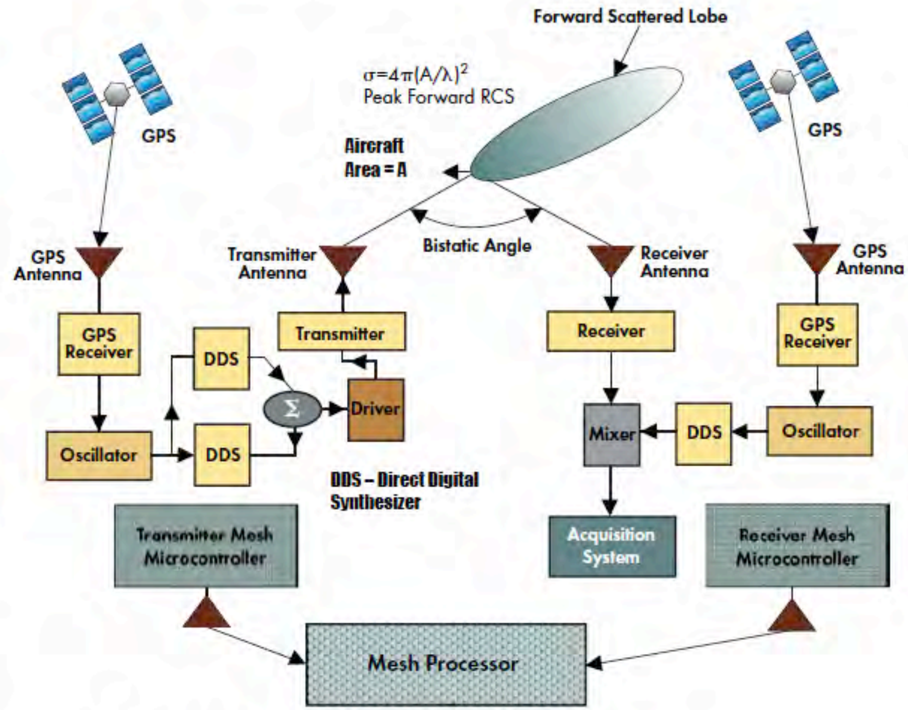

Figure 1. Forward scatter radar layout.

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Radiant mapping with forward scatter radars: a new approach

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Giuseppe Pupillo, Giordano Cevolani, Giorgio Grassi

In this paper we describe a method to map radiant positions of meteor streams developed for forward scatter radars with the ability of measuring the angle of arrival of meteor echoes. A system with these qualifications, called MIRA (Meteor Interferometric Radar Array), will soon replace the actual BLM radar system in Italy. Preliminary results from numerical simulations are also shown here.

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Location of MBC reflection points – x,y,z

Other papers with potentially useful components (we have these but don't give clippings here)

- **Passive Radar and the Low Frequency Array**

  Frank D. Lind[1], John D. Sahr[2]

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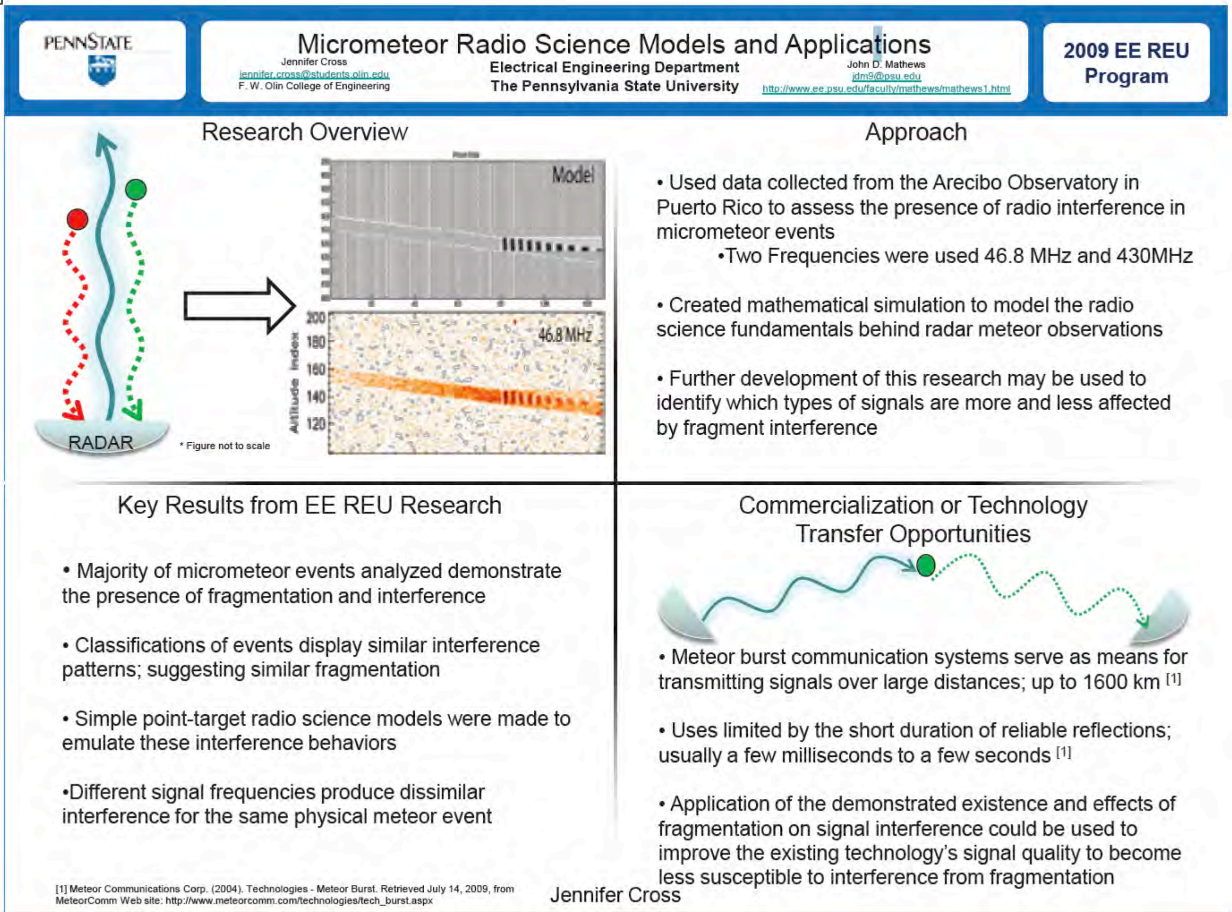
  flind@haystack.mit.edu

  [2] *Department of Electrical Engineering, University of Washington, Box 352500, Seattle, WA 98152 USA*
  jdsahr@u.washington.edu

- 

PENNSTATE

Micrometeor Radio Science Models and Applications

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2009 EE REU Program

Research Overview

Approach

- Used data collected from the Arecibo Observatory in Puerto Rico to assess the presence of radio interference in micrometeor events
  - Two Frequencies were used 46.8 MHz and 430MHz
- Created mathematical simulation to model the radio science fundamentals behind radar meteor observations
- Further development of this research may be used to identify which types of signals are more and less affected by fragment interference

Key Results from EE REU Research

- Majority of micrometeor events analyzed demonstrate the presence of fragmentation and interference
- Classifications of events display similar interference patterns; suggesting similar fragmentation
- Simple point-target radio science models were made to emulate these interference behaviors
- Different signal frequencies produce dissimilar interference for the same physical meteor event

Commercialization or Technology Transfer Opportunities

- Meteor burst communication systems serve as means for transmitting signals over large distances; up to 1600 km [1]
- Uses limited by the short duration of reliable reflections; usually a few milliseconds to a few seconds [1]
- Application of the demonstrated existence and effects of fragmentation on signal interference could be used to improve the existing technology's signal quality to become less susceptible to interference from fragmentation

[1] Meteor Communications Corp. (2004). Technologies - Meteor Burst. Retrieved July 14, 2009, from MeteorComm Web site: http://www.meteorcomm.com/technologies/tech_burst.aspx

Jennifer Cross

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33rd Annual Precise Time and Time Interval (PTTI) Meeting

PASSIVE METEORIC SYNCHRONIZATION OF TIME SCALES

Ivan E. Antipov, Veronika V. Bavykina,
Yuriy A. Koval, and Goergiy V. Nesterenko
Kharkov State University of Radio Electronics (KTURE), Ukraine

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Firefly (or another name) V -1.0

Nationwide Wireless for PNT, Dynamic GIS, and Internet of Things *(includes ITS V2V)*

Spectrum and Methods
- Meteor Burst Communications (MBC), 30-50 MHz (plus/ minus), also using Ionospheric and Tropospheric propogation.
- Terrestrial Wave Communications (TWC), 30-50 MHz.
- Mesh Net (MN), 30-50, 200, and 900 MHz.
- Ultrawideband (UWB) & other for very local. GNSS, INS, N-RTK, etc. (not our core, but important).

Phases
- Phase 1 facilities from DOA and other Fed agencies.
- Phase 1 will achieve viability and fund Phase 2. Full US coverage in MBC and set-up for extensive TWC+MN coverage.
- Phase 1: Approx. 6 MBC master base stations (MBs) and 6 collocated TWC base stations (TBs).
- Phase 2: Add many additional MBs and a larger number of TBs.

Main Tech: Coordinated Cognitive Radio (CCR)
- We hold sufficient exclusive-licensed spectrum (ELS) for conventional (non-cognitive) methods.
- But we plan to swap some 200 and 900 MHz for 30-50 MHz on CR rights basis (CRR), using the "holes" in time and space. (MBC is a analogous to CR. See Weiss, *Spatio-Temporal Spectrum Holes…*, IEEE, 2010.)
- If we get that, then enduser devices will use 30-50 MHz on ELS and the rest via CR.

Approach and Competitors
- No effective competitors (with cost-effective, very wide reach) currently and none with known sprectrum resources or vision/ interest.
- Approach: our Skybridge Spectrum Foundation- nonprofit to assist government (or its/ public's) goals, and our LLCs on long-term "green"-enterprise basis. Partner with some companies and gov agencies.

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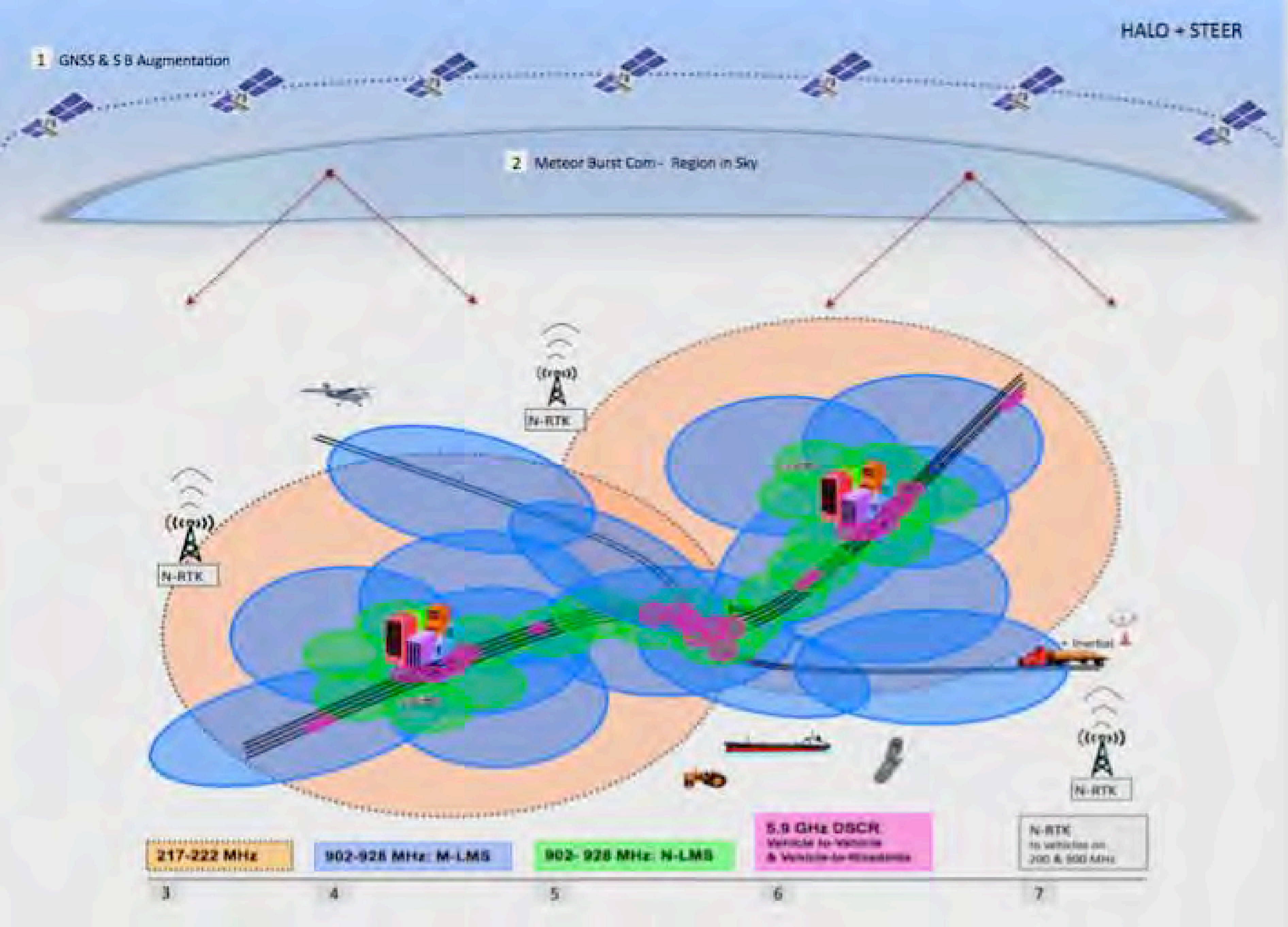


Functions *(F)*

1. Full coverage nationwide, land & far offshore.
2. Redundant coverage in all but most remote areas.
3. MBC *[2]* has performance in later stage noted in slide below.
4. Other comm layers *[3-7]* have higher speed, constant coverage.
5. No cost delivery of High Accuracy Location (HALO) & essential 1- & 2- way wireless data (STEER: Smart Transport, Energy & Environment Radio) for core transport & other critical apps.
6. Many-fold extra capacity remains.
7. Tight integration of mulit-mode HALO (GNSS, SBAg, INS, terrestrial multilateration, etc.) with STEER.
8. Use of Commercial Wireless (CW) to augment, and provision of some HALO and STEER to CW.

- *Replicable worldwide. Enviro, humanitarian & commercial combined. Open concepts & core tech (in stage 2).*

Construction & Operation *GreenCom JVs.*

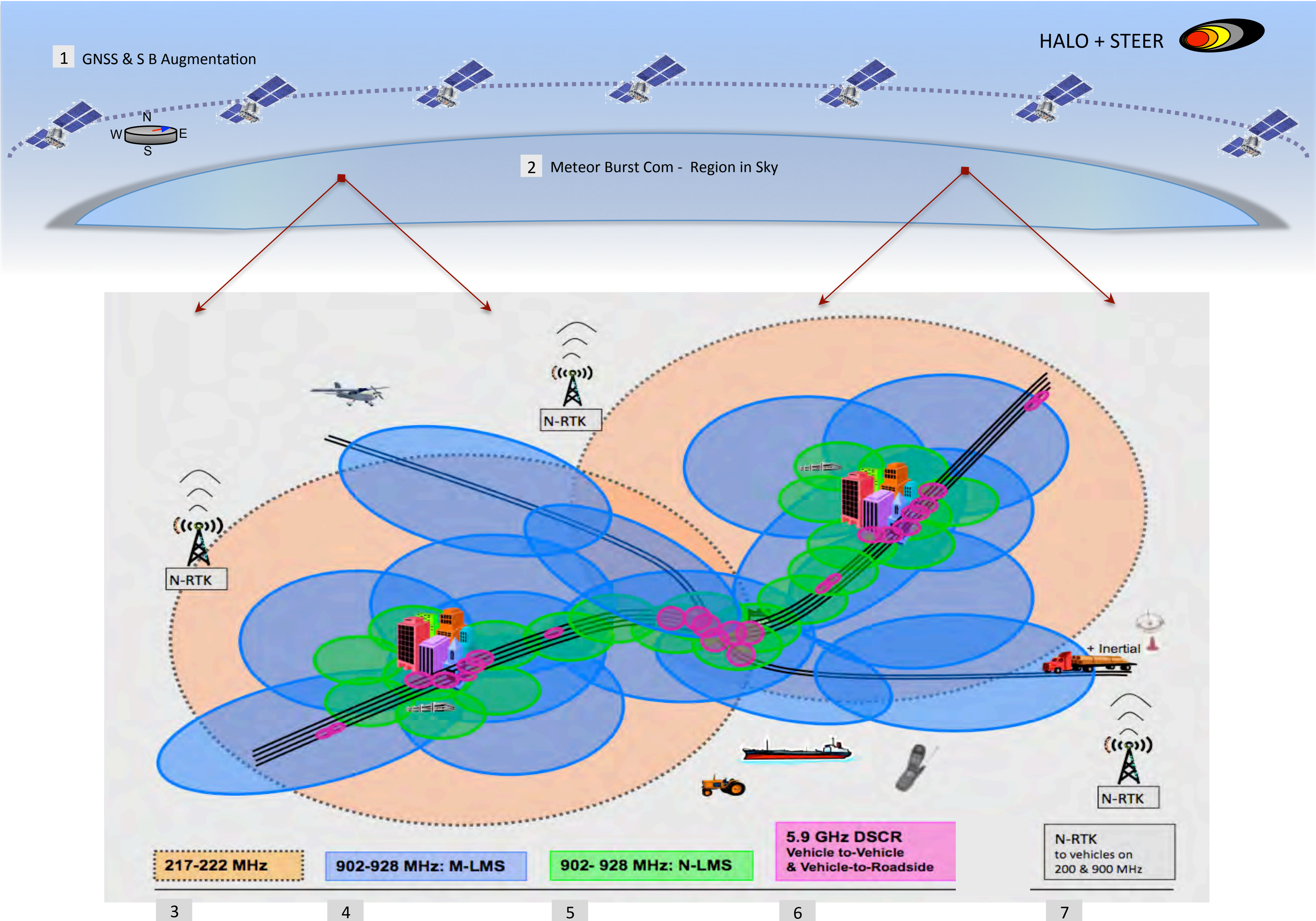
(i) Regional joint ventures, becoming nationwide in time. Vast majority of most critical network assets exist now. No insurmountable tech advancement. A lot of integration. Huge and growing need vs. costs. Good political environment for the deliverables. Core members:

1. *SkyTel* spectrum licenses, and certain other spectrum targeted, see above and a slide below.
2. '*Roger*' company supplies HALO and a good bit of STEER tech and equipment. A key *GIS company* provides dynamic GIS. Core tech should be open, and perhaps standards based, at least in stage 2.
3. Power utilities* and Stage and Federal agencies supply vast majority of wireless and RTK sites, comm links, power, and build and operate and upgrade (with tech expert oversight).
4. Appropriate green-tech investor funds cash needs to break even.
5. Nonprofits and government grants support *F5*.

* See Exhibit 1 below.

GreenCom (*CG*) JV Returns

1. Agencies get public goals.
2. Nonprofits get charitable goals (*F2*).
3. Cash investors get good returns & experience.
4. Utilities get mostly paid in wireless capacity for smart grid, fleets, V2G.
5. SkyTel get some '2' and and extra system capacity for compatible uses.
6. *Roger* and GIS companies get (i) some of '2', (ii) sales of products in expanded markets, and (iii) leadership positions in *GC* US and International.
7. Roger company may also get GC capacity.



LTE will work in the 200, 900, and 5900 MHz depicted. In US and Japan, 700-900 MHz LTE are planned including for ITS, smart grid, public safety, etc. Vehicles allow more powerful computing, which is basis of advanced radio communications and location. Energy producers and distributors have wireless infrastructure for the system, and would be end users.